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*1992 Annual Report
East Hennepin Avenue Site
Minneapolis, Minnesota*

*Prepared for
General Mills, Inc.*

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1992 ANNUAL REPORT

EAST HENNEPIN AVENUE SITE

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1992 ANNUAL REPORT EAST HENNEPIN AVENUE SITE

1.0 INTRODUCTION

This report summarizes the results from annual monitoring and remedial action operations conducted at the East Hennepin Avenue site during 1992. The monitoring data was collected and submitted quarterly to the MPCA project leader. The 1992 monitoring was carried out in response to the requirements of Part II of Exhibit A to the October 23, 1984 Response Order by Consent between General Mills and the Minnesota Pollution Control Agency (MPCA); the January 1985 Groundwater Pump-out System Plan - East Hennepin Avenue Site; the Minnesota Department of Natural Resources Water Appropriation Permits (85-6144 and 85-6145); the Magnolia Member Aquifer Pump Test Report - Remedial Action Design Plan; the NPDES Permit MN 0056022; and, the 1992 Monitoring Plan.

The 1992 groundwater monitoring data (water levels and water quality) is provided in Section 2.0 of this report. The validity of the 1992 data is evaluated in Appendix A and is summarized in Section 3.0. Results of the 1992 monitoring are discussed in Section 5.0 along with an evaluation of historical trends in groundwater levels and water quality at the site. Historical data is also summarized in Appendix B. The effectiveness of the groundwater pump-out system is discussed in Section 6.0. Recommendations for 1993 are presented in Section 7.0. The Recommended 1993 Operation and Monitoring Plan is provided in Appendix C. Appendix D contains the Magnolia Pump-Out System test data and Appendix E the well logs for the Magnolia pump-out wells.

The East Hennepin Avenue site is located in Minneapolis, Minnesota as shown on the regional location map in Figure 1. A map of the site is shown as Figure 2. The generalized geologic column for the site is shown in Figure 3.

2.0 GROUNDWATER MONITORING

2.1 Water Level Monitoring

The 1992 monitoring program involved the measurement of water levels from 15 wells screened in the glacial drift (five pump-out wells and ten monitoring wells); 12 wells screened in the Carimona Member of the Platteville Formation (one pump-out well and 11 monitoring wells); seven wells open to the Magnolia Member of the Platteville Formation (two pump-out wells and five monitoring wells); and, from four monitoring wells screened in the St. Peter Sandstone. All monitoring activities were carried out in accordance with the 1992 Monitoring Plan (see Appendix B of the 1991 Annual Report) and the 1985 Quality Assurance/Quality Control Plan.

The results from 1992 water level monitoring are presented in Sections 2.1.1 through 2.1.4. Historical water elevation data for the glacial drift wells, Carimona Member wells, Magnolia Member wells, St. Peter wells, and pump-out wells is provided in Appendix B of this report.

2.1.1 Glacial Drift

Groundwater elevations were measured in glacial drift monitoring wells during the second (May) and fourth (November) quarter sampling events of 1992 at the locations shown in Figure 4. A summary of 1992 water level monitoring results is presented in Table 1. A cross section of the glacial drift groundwater surface for both monitoring periods is shown in Figure 5. The location of the cross section (A-A') was shown on Figure 4. The estimated glacial drift groundwater contours for each monitoring period are shown in Figures 6 and 7. The average annual fluctuation of the potentiometric surface for the glacial drift during 1992 was approximately 0.6 feet.

2.1.2 Carimona Member of Platteville Formation

Groundwater elevations were also measured in the Carimona Member monitoring wells during May and November of 1992 at the locations shown in Figure 8. A summary of 1992 water level monitoring results is presented in Table 2. The Carimona potentiometric surface elevations

for each monitoring period are shown in Figures 9 and 10. The average annual fluctuation of the potentiometric surface for the Carimona Member in 1992 was approximately 0.4 feet.

2.1.3 Magnolia Member of Platteville Formation

The potentiometric surface elevations were measured in the Magnolia Member monitoring wells during May and November of 1992 at the locations previously shown in Figure 11. A summary of 1992 water level monitoring results is presented in Table 3. The Magnolia potentiometric surface elevations for each monitoring period are shown in Figures 12 and 13.

The average annual fluctuation of the potentiometric surface for the Magnolia during 1992 was 3.7 feet. The large degree of fluctuation was due to the start-up of the Magnolia pump-out system. Water elevations dropped an average of 4.6 feet in the monitoring wells closest to the site (Wells TT, VV, OO, and QQ). Monitoring Well ZZ, located furthest up-gradient from the site appears to have been unaffected by the Magnolia pump-out system.

2.1.4 St. Peter Sandstone

The potentiometric surface elevations were measured in the St. Peter Sandstone monitoring wells during May and November of 1992 at the locations shown in Figure 14. A summary of 1992 water level monitoring results is presented in Table 4. The St. Peter potentiometric surface elevations for each monitoring period are shown in Figures 15 and 16. The average annual fluctuation of the potentiometric surface for the St. Peter Sandstone during 1992 was approximately 0.8 feet.

2.2 Water Quality Monitoring

The 1992 monitoring program involved the collection of water quality samples from monitoring wells screened in the glacial drift aquifer; wells screened in the Carimona and open to the Magnolia Members of the Platteville Formation; wells screened in the St. Peter Sandstone; and one well open to the Prairie du Chien/Jordan. The monitoring activities were carried out in accordance with the 1992 Monitoring Plan and the 1985 Quality Assurance/Quality Control Plan.

The results from 1992 water quality monitoring are discussed in the following section and in Section 5.0. Historical water quality data for glacial drift wells, Carimona Member wells, Magnolia Member wells, St. Peter Sandstone wells, Prairie du Chien/Jordan well, pump-out wells, and the groundwater treatment system influent and effluent are presented in Appendix B. (Note: The 1992 water quality monitoring results are considered to be valid as discussed in Section 3.0 and Appendix A of this report.)

2.2.1 Glacial Drift

Groundwater samples were collected from ten glacial drift monitoring wells during May of 1992 and from five glacial drift monitoring wells during November 1992. Samples collected during May 1992 were analyzed for the parameters listed in Table 5. Samples collected during November 1992 were analyzed for TCE. The results from the laboratory analyses are presented in Table 6. The reported concentrations of TCE and the sum of volatile organic compounds (VOCs) are also shown in Figures 17 through 19. The 1985 through 1992 TCE concentrations for glacial drift Wells Q, X, 1, B, V, 3, S, and T are shown in Figure 20.

2.2.2 Carimona Member of Platteville Formation

Groundwater samples were collected from eleven monitoring wells open to the Carimona Member of the Platteville Formation during May 1992, and from four Carimona Member monitoring wells during November 1992. Carimona pump-out Well 108 was also sampled during May of 1992. A fourth quarter sample (November) was not collected from Well 108 due to the well being shut down in September. The samples collected during May 1992 were analyzed for the parameters listed in Table 5. The results from the laboratory analyses are presented in Table 7. The concentration of TCE and the sum of VOCs are shown in Figures 21 through 23. The 1985 through 1992 TCE concentrations for Carimona Wells BB, 108, 13, 10, 11, and WW are shown in Figure 24.

2.2.3 Magnolia Member of Platteville Formation

Groundwater samples were collected from four monitoring wells open to the Magnolia Member of the Platteville Formation during May 1992, from one Magnolia Member monitoring well in June 1992 and from three Magnolia Member monitoring wells during November 1992. The samples collected during May and June 1992 were analyzed for the parameters listed in Table 5. The samples collected during November were analyzed for TCE. The results from the laboratory analyses are presented in Table 8. The concentration of TCE and the sum of VOCs are shown in Figures 25 through 27. The 1985 through 1992 TCE concentrations for Magnolia Member Wells ZZ, OO, VV, QQ, and TT are shown in Figure 28.

2.2.4 St. Peter Sandstone

Groundwater samples were collected from four monitoring wells screened in the St. Peter Sandstone during May 1992 and one St. Peter Sandstone monitoring well in November 1992. Samples collected during May were analyzed for the parameters listed in Table 5. Samples collected during November were analyzed for TCE. The results from the laboratory analyses are presented in Table 9. The concentration of TCE and the sum of VOCs are shown in Figures 29 through 31. The 1985 through 1992 TCE concentrations for St. Peter Sandstone Wells 200, 201, 202, and 203 are shown in Figure 32.

2.2.5 Prairie du Chien/Jordan

Groundwater samples were collected from the Henkel well during May and November of 1992. The samples were analyzed for the parameters listed in Table 5. The results from the laboratory analyses are presented in Table 10.

2.2.6 Downgradient Groundwater Pump-Out System

Flow weighted composite groundwater samples were collected from the downgradient pump-out well system discharge during January, May, August, and November of 1992 (1st, 2nd, 3rd, and 4th quarters). The samples collected during May and November of 1992 were analyzed for the parameters listed in Table 11. The samples collected during January and August of 1992 were analyzed for TCE. The results from the laboratory analysis are presented in Table 12. The 1985 through 1992 TCE concentrations for the downgradient groundwater pump-out system discharge is shown in Figure 33.

2.2.7 Site Groundwater Treatment & Groundwater Pump-Out System

Groundwater treatment system influent and effluent samples were collected quarterly in 1992, during January, May, August, and November. Influent to the treatment system is composed of groundwater pumped from Wells 108, 109, and 110. The samples collected in January and August were analyzed for TCE. The samples collected in May and November were analyzed for the parameters listed in Table 11. The sample collected from the groundwater treatment system influent in May was also analyzed for priority pollutant volatile organics. The results from the laboratory analyses are presented in Tables 13 and 14. The 1985 through 1992 TCE concentrations for the groundwater treatment system influent and effluent are shown in Figure 33.

Wells MG1 and MG2 were added to the site groundwater pump-out system in September of 1992. Effluent from the wells is discharged directly to the Minneapolis storm sewer. A flow weighted composite sample was collected from the effluent of Wells MG1 and MG2 in November 1992. The results from the laboratory analysis are presented in Table 15.

3.0 QUALITY ASSURANCE PROCEDURES

Quality assurance procedures described in the February 1985 Quality Assurance/Quality Control (QA/QC) Plan were followed during collection and analysis of the water quality samples. Quality assurance procedures involved internal and external quality review procedures. The

results from the quality review are presented in Appendix A. The results from the quality review indicate the 1992 data met the data quality objectives.

4.0 REMEDIAL ACTION OPERATIONS

The following sections summarize the site construction remedial action operation and maintenance activities conducted at the East Hennepin Avenue site during 1992. Remedial actions during 1992 consisted of the start-up and operation of Magnolia Member pump-out Wells MG1 and MG2 and the operation of the groundwater pump-out and treatment systems.

4.1 Magnolia Member Pump-Out System

This section describes the construction and start-up monitoring performed to verify the effectiveness of the new Magnolia Member Pump-out Wells MG1 and MG2. Effectiveness was determined by measuring the steady-state drawdown induced in the Magnolia Member and overlying Carimona Member of the Platteville Formation during pumping of the two pump-out wells at approximately 95 gallons per minute (gpm) each. In addition, the effectiveness of the Magnolia Pump-out Wells was compared with that of Carimona Pump-out Well 108. The methods used to monitor pumping rates and water levels, results of the monitoring, and conclusions are presented in Sections 4.1.1 through 4.1.4.

4.1.1 Pump-Out System Construction

Two 6-inch diameter wells were completed in the Magnolia Member of the Platteville Formation in May and June of 1991 (Wells MG1 and MG2). The locations of these wells are shown in Figure 11. Both wells are located in the southeast corner of the site. Specifications for the construction of these wells were submitted to and approved by the MPCA, the Minnesota Department of Health, and the City of Minneapolis. The wells were designed to be used as pump-out wells. The wells were installed by E.H. Renner and Sons, Inc.

The wells are constructed of a 12-inch nominal diameter steel casing installed in a 17.5-inch diameter borehole from the ground surface to the top of the Carimona Member of the Platteville

Formation. The annulus between the borehole and the outer casing was filled with neat cement grout. An 11-7/8 inch diameter borehole was advanced through the outer casing to the top of the Magnolia Member of the Platteville Formation and a 6-inch nominal diameter steel casing was installed. The annulus between the two casings was grouted with neat cement and allowed to set for 48 hours. A 5-7/8 inch diameter open borehole was advanced approximately 10 feet, through the estimated thickness of the Magnolia Member. Well MG1 is open from depths of 61.5 to 72 feet and Well MG2 is open from 60 to 72 feet below grade. Boreholes were advanced using rotary drilling methods. Wells were developed by surging with a surge block and pumping. Well construction and boring logs are presented in Appendix E.

Construction of the pump-out well forcemains from the pitless adapter to the stripper tower occurred during May 1992. The force mains consist of two 3-inch high density polyethylene pipes that are connected to the base of the stripper tower. The discharge from each forcemain is monitored by a flow meter that measures instantaneous flow rate and cumulative volume in gallons.

4.1.2 Start-Up Monitoring Methods

Water levels in the two pump-out wells were monitored for 23 hours prior to the beginning of the start-up test using PXD-161 pressure transducers connected to a Hermit 1000B data logger manufactured by In-Situ Inc. of Laramie, Wyoming. Carimona Member Pump-out Well 108 was operating for the first 20 hours. Manual measurements were taken for the first seven days of the monitoring period to verify that the transducers and data logger were operating correctly (Table D-1, Appendix D).

Water levels in 16 monitoring wells were measured approximately 21 hours and 2 hours before the beginning of the start-up test. Five of the monitoring wells are completed in the Magnolia Member (OO, QQ, TT, VV, and ZZ) and 11 of the monitoring wells are completed in the overlying Carimona Member (8, 9, 10, 11, 12, 13, BB, RR, SS, UU, WW). Measurements were taken manually using an electronic water level indicator manufactured by Solinst, Inc.

Carimona Member Pump-out Well 108 was turned off at 08:19 on September 22, 1992. Water levels in Magnolia Member Pump-out Wells MG1 and MG2 did not respond to the shut-off of Well 108.

Pump-out Well MG2 was started at 10:15 on September 22, 1992. Debris in the discharge line restricted operation of the flow meter and the pump was turned off. Pump-out Well MG2 was re-started at 11:44. The flow meter malfunctioned again at 12:00. The pumps in both Pump-out Wells MG1 and MG2 were started for the final time at 12:25 and operated continuously through the end of the start-up monitoring period on October 1, 1992. The pumps continued to operate after the monitoring period ended.

Pumping rates were measured using turbine-type flow meters that measure instantaneous flow rate and total volume pumped. The pumping rates were checked twice daily and adjusted if the rate in either well was greater than 98 gpm or less than 92 gpm (Table D-2, Appendix D). Wells MG1 and MG2 were pumped at an average rate of 97 gpm over the start-up period.

Water levels in the monitoring wells were measured twice daily for the first three days of the test and once a day for the remainder of the monitoring period (Table D-3, Appendix D).

4.1.3 Start-Up Monitoring Results

Water levels throughout the monitoring network rose approximately 0.2 feet prior to the beginning of the test (Table D-3, Appendix D). This trend had reversed in all of the monitoring wells except Well 12 when water levels were measured approximately three hours after the pump-out wells were started.

Based on the measured drawdowns at the beginning of the start-up monitoring period, when Pump-out Well MG2 was operated alone, Pump-out Well MG2 has a specific capacity of 16 gpm/ft of drawdown. Based on the results from the pumping test of Well MG1 (Barr, 1991), Well MG1 has a specific capacity of 14 gpm/ft of drawdown. Well interferences between MG1 and MG2 caused total drawdowns of approximately 14 feet in both wells during the start-up period as shown in Figure 34, (Table D-1, Appendix D). After Day 4, the pumping rates required no

further adjustment. During Day 5 through Day 8, the water levels in the pumped wells showed a daily variation of approximately 0.5 feet (Figure 34).

During the start-up monitoring, the drawdowns measured in wells completed in the Magnolia Member ranged from 1.6 feet in Well ZZ to 6.6 feet in Well TT (Table D-3, Appendix D). In general, the water levels reached a steady state value within three hours of the beginning of pumping. The drawdowns measured in the Magnolia Member monitoring wells are not proportional to the distance from the pump-out wells as shown in Figure 35.

During the start-up monitoring, the drawdowns measured in the monitoring wells completed in the Carimona Member ranged from 0.77 feet at Well 12 to 2.7 feet at Well SS. The drawdown measured in the Carimona Member monitoring wells is not proportional to the distance from the pump-out wells as shown in Figure 36. With the exception of Wells BB, SS, and 12, the drawdown was essentially uniform (approximately 1.6 feet) in the Carimona Member monitoring wells.

With the exception of Well SS and Well 12, water levels in the Carimona Member monitoring wells reached steady state within 24 hours of the beginning of pumping. The water level in Well SS reached steady state within three hours of the beginning of pumping. The water level in Well 12 did not reach a steady state during the start-up monitoring period. The drawdown measured in Well 12 at the end of the monitoring period was the smallest response measured in any of the wells.

Groundwater elevations in the Magnolia Member wells rose 0.64 feet to 1.0 feet from the end of the start-up monitoring period on October 1, 1992 to November 2, 1992 as shown in Figure 37.

With the exception of Wells 12 and SS, groundwater elevations in the Carimona Member wells rose 0.73 feet to 0.93 feet from October 1, 1992 to November 2, 1992 as shown in Figure 38. The groundwater elevation in Well 12 fell 0.95 feet. The water level in Well SS had the smallest change of any of monitoring wells (0.07 foot drop).

Four of the Carimona Member wells are nested with Magnolia Member wells: Well WW with Well VV, Well SS with Well TT, Well RR with Well OO, and Well 13 with Well ZZ as shown in Figure 39. The gradient is upward from the Magnolia Member to the Carimona Member at nest 13/ZZ and downward in the other three nests (Table D-4, Appendix D). The difference in groundwater elevations in these well nests varied by a maximum of 0.30 feet from May 11 to September 22, 1992. By the end of the 8-day start-up monitoring period, the downward gradient in nests WW/VV, SS/TT, and RR/OO had increased by 3.60 feet, 3.83 feet, and 4.45 feet, respectively (Figure 39). The upward gradient at nest 13/ZZ decreased by 0.01 feet.

4.1.4 Conclusions Based on Start-Up Monitoring

Based on the contrast in drawdown between the Magnolia Member and Carimona Member during the start-up monitoring period, these units form a layered groundwater flow system with hydraulic interconnection that is greatly influenced by Magnolia Member pump-out Wells MG1 and MG2. Based on the distribution of drawdowns noted in both the Magnolia Member and Carimona Member during the start-up monitoring period, the groundwater flow system does not represent Darcy flow. In Darcy flow, the drawdown at a given monitoring well in the pumped layer is directly proportional to the pumping rate and inversely proportional to the distance from the pumping well. The drawdown at a given monitoring well in the unpumped layer is directly proportional to the hydraulic gradient induced between the layers at that point in the system.

Extractable groundwater in the Platteville Formation is believed to occur primarily in secondary permeability features such as fractures and solution cavities. If the secondary permeability features are regularly spaced and have sufficient density at the scale of a given aquifer test, the aquifer will have a similar hydraulic response to a granular porous medium (Freeze and Cherry, 1979, p. 73). If the secondary permeability features are randomly distributed or widely distributed compared to the scale of the aquifer test, the drawdown at a given well is likely controlled by the water-bearing capacity of the fractures intersected by the well and the degree of interconnection between those fractures and the pump-out wells.

In the case of the Magnolia Member, the drawdown due to pumping of MG1 (Barr, 1991) and both MG1 and MG2 appears to exhibit anisotropy, however, the number and distribution of monitoring wells is not sufficient to determine this with certainty. Modeling techniques used for granular media were used to model the effects of the pump-out system (Barr, 1991). The similarity of the predicted and measured water levels in the Magnolia Member pump-out and monitoring wells suggests that these techniques are appropriate to model groundwater flow in the Magnolia Member as shown in Figure 40. The greatest difference between the measured and predicted water level was at Well ZZ, which acts hydraulically like Carimona Member Well 13.

In the case of the Carimona Member, the density of the fractures and cavities appears to be too low for the aquifer response to be modeled as a granular porous medium. Although water levels in the Carimona Member wells respond to pumping of the Magnolia Member pump-out wells, the magnitude of the response does not appear to correspond with either the magnitude of the hydraulic gradient between the two members or the magnitude of the change in hydraulic gradient induced by pumping of Wells MG1 and MG2. The magnitude of the drawdown in the Carimona Member wells is generally less than half that of the nested Magnolia Member wells, suggesting a leaky confining layer exists between the Carimona Member and the Magnolia Member.

The drawdown in Wells 13 and ZZ was 1.6 feet and 1.6 feet, respectively, suggesting that Well ZZ is not hydraulically connected to the same fracture system as the other Magnolia Member monitoring and pump-out wells.

Monitoring Well 12 is apparently not hydraulically connected to the same fracture system as the other Carimona Member monitoring wells. The long response time for water levels in Well 12 may reflect withdrawal of water from the primary porosity of the Carimona Member. Monitoring Well SS appears to be the most directly connected to the Magnolia pump-out wells.

The Magnolia Member Pump-out Wells have a greater influence on the vertical gradient from the Carimona Member to the Magnolia Member than did former Carimona Pump-out Well 108. The influence of Well 108 was evaluated during the 1991 pumping test of Well 108 (Barr, 1991) and during the 1984 start-up monitoring of Well 108 (Barr, 1985). The drawdowns in the

Carimona wells during the 1984 start-up monitoring of Well 108 ranged from 0.7 feet at Well SS to 1.1 feet at Well WW after eight days of pumping (three days at 37 gpm and five days at 54 gpm). This compares to drawdowns of 0.77 feet (Well 12) to 2.74 feet (Well SS) during pumping of Wells MG1 and MG2. The specific capacity of Well 108 has declined markedly since 1984. Based on the increased vertical gradient toward the Magnolia Member and the large area over which water levels in the Carimona Member wells responded to pumping of MG1 and MG2, the Pump-out Wells MG1 and MG2 are believed to capture groundwater from the Carimona Member more effectively than Well 108.

4.2 Existing Groundwater Pump-Out Systems

The East Hennepin Avenue site groundwater pump-out systems consist of the site glacial drift pump-out system (Wells 109 and 110) (Figure 4), the site Carimona pump-out system (Well 108) (Figure 4), the site Magnolia pump-out system (Wells MG1 and MG2) (Figure 2) and the downgradient glacial drift pump-out system (Wells 111, 112, and 113) (Figure 4). The performance of each individual pump-out system is discussed in Sections 4.2.1 through 4.2.4. The average monthly pumping rate for each of the pump-out wells is presented in Table 16.

4.2.1 Site Glacial Drift

The site glacial drift pump-out well system (Wells 109 and 110) is designed to contain and remove groundwater with a concentration of trichloroethene (TCE) exceeding 270 µg/L from the glacial drift aquifer. The combined average pumping rate for the site glacial drift pump-out well system during 1992 was 91 gallons per minute. The average monthly pumping rates for the individual pump-out wells ranged from 18 to 60 gallons per minute. A total volume of approximately 47 million gallons of groundwater was removed from the glacial drift aquifer by the site glacial drift pump-out system. The site glacial drift pump-out system operated at a combined yearly average operating time of 99.5 percent during 1992.

Groundwater removed by the site glacial drift pump-out system during 1992 was treated by air stripping. The effluent from the air stripper is discharged to the Minneapolis storm sewer network. The site glacial drift pump-out system began operation on November 1, 1985.

4.2.2 Carimona Member of the Platteville Formation

Carimona Pump-out Well 108 was shut down on September 23, 1992. The well was shut down due to the dropping yield of the aquifer in the vicinity of the well. The new Magnolia Member Pump-out System replaces the Carimona Pump-out Well System. Magnolia pump-out wells MG1 and MG2 are more effective in extracting groundwater from the Carimona Member than former Carimona Pump-out Well 108 (Section 4.1).

Prior to shut down, Well 108 had an average pumping rate of 9 gallons per minute. This compares to pumping rates of 37 to 54 gpm in 1985. We believe the drop in yield is the result of calcification of fractures in the immediate vicinity of the well.

A total volume of approximately 3.5 million gallons of groundwater was removed from the Carimona Member by Well 108 during 1992. Well 108 operated at an average running time of 100 percent prior to shut down.

Groundwater removed by the Carimona Member pump-out system during 1992 was treated by air stripping. The effluent from the air stripper is discharged to the Minneapolis storm sewer network. The Carimona Member pump-out system began operation on November 1, 1985.

4.2.3 Magnolia Member of the Platteville Formation

The Magnolia pump-out system (Wells MG1 and MG2) is designed to contain and remove groundwater with a concentration of TCE exceeding 27 µg/L from both the Magnolia and Carimona Members of the Platteville Formation. Operation of the pump-out wells began on September 23, 1992. After start-up, Wells MG1 and MG2 operated at a combined average of 182 gallons per minute. A total volume of approximately 25 million gallons was removed from the Carimona and Magnolia Members by Wells MG1 and MG2 during the fourth quarter of 1992.

Well MG1 operated at an average running time of 99 percent and Well MG2 operated at an average running time of 100 percent, following start-up.

4.2.4 Downgradient Glacial Drift

The downgradient glacial drift pump-out system (Wells 111, 112, and 113) is designed to contain and remove groundwater with a concentration of TCE exceeding 270 µg/L.

The downgradient glacial drift pump-out well system operated at a combined annual average rate of 277 gallons per minute. The average monthly pumping rates for the individual downgradient pump-out wells ranged from 29 to 122 gallons per minute. A total volume of approximately 146 million gallons of groundwater was removed from the glacial drift aquifer by the downgradient glacial drift pump-out system during 1992. The downgradient pump-out system operated at a combined yearly average running time of nearly 100 percent.

Groundwater removed by the downgradient pump-out well system is discharged directly to the Minneapolis storm sewer network. Passive air stripping occurs in the storm sewer between the downgradient pump-out system discharge point and the Mississippi River. The downgradient pump-out system began operation on December 5, 1985.

4.3 Maintenance and Downtime

The site and downgradient pump-out wells were operated continuously at the maximum sustainable yield of the pumps or aquifer during 1992, with the exception of shut downs caused by electrical or mechanical failures, and the need for well maintenance.

Maintenance during 1992 included rewiring of the control circuits for Wells 108, 109, and 110, and replacement of the flow meter on Well 110. Well 109 was shut down for one day in March for cleaning of the pump, meter, and piping. Well 109 was also shut down for one day in May while the well was flushed, jetted, and chlorinated as part of the maintenance required to treat bacterial growth occurring in the well. Well 108 was shut down in September, following start-up of the Magnolia Member pump-out system.

Maintenance to the downgradient pump-out wells in 1992 involved replacing the riser pipes in Wells 111 and 113.

Magnolia Member pump-out Well MG1 was not operating for 12 days in December due to flow meter repair.

Operation down time occurring during 1992 for the glacial drift, Carimona and Magnolia Member pump-out wells is summarized in Table 17.

4.4 Groundwater Treatment System

The groundwater treatment system consists of a stripper tower located at the former disposal site. The tower is designed to remove 99 percent of volatile organic compounds from influent groundwater at a discharge rate of 150 gpm. The groundwater treatment system is required to treat influent groundwater to an annual average effluent concentration of less than 50 µg/L trichloroethene (TCE), and to a daily maximum concentration of less than 100 µg/L TCE. The treatment system is also required to achieve a 98 percent removal efficiency as an annual average and a 95 percent daily removal efficiency based on the ratio of total VOC concentration in the system influent versus effluent.

During 1992 the tower received influent from site glacial drift pump-out Wells 109 and 110, and from the Carimona Member pump-out Well 108 while in operation. The stripper tower began operation on November 11, 1985.

5.0 DISCUSSION OF RESULTS

This section discusses the water quality data results for samples collected from glacial drift, Carimona Member, Magnolia Member, St. Peter Sandstone, and Prairie du Chien/Jordan monitoring wells. Also discussed are the water quality results for groundwater pump-out system wells, and the groundwater treatment system. Historical water quality data for each location is provided in Appendix B.

A graphical representation of the historical water quality data is also provided in Figures 20, 24, 28, 32, and 33.

5.1 Site Glacial Drift

The results from the analysis of groundwater samples collected from the glacial drift during 1992 indicate the TCE and total VOC concentrations ranged from less than the laboratory reporting limit (Wells T, U, and X) to 770 µg/L at Well S (Table 6).

The results from the analysis of groundwater samples collected from the glacial drift Wells B, Q, W, U, and X indicate TCE concentrations have decreased since the start-up of the site glacial drift pump-out system in 1985. The results from the analysis of groundwater samples collected from Wells S, V, T, 1, and 3 during 1992 indicate TCE concentrations are similar to historical water quality data collected from 1985 to 1991.

The groundwater elevation data indicate the direction of groundwater flow in the glacial drift is to the southwest. The data also indicate that 1992 groundwater elevations are similar to historical water elevation data collected from 1985 to 1991. Water level measurements collected during 1985 and 1986, following start-up of the groundwater containment system, demonstrated the effectiveness of the site and downgradient pump-out systems in containment of the glacial drift groundwater in areas where TCE concentrations exceeded 270 µg/L. Glacial drift groundwater elevation data collected during 1992 indicate the containment zone established during 1985 and 1986 has been maintained.

5.2 Carimona Member of Platteville Formation

The results from the analysis of groundwater samples collected from the Carimona Member during 1992 indicate the TCE concentrations ranged from less than the laboratory reporting limit (Well 12) to 870 µg/L at Well BB (Table 7). The total VOCs concentration ranged from not detected (Well 12) to 990 µg/L (Well BB).

The results from the analysis of groundwater samples collected from Carimona Member Wells 8, 10, and WW indicate TCE concentrations have declined since the start-up of the Carimona Member pump-out system in 1985. The results from the analysis of groundwater samples collected from Wells RR, SS, UU, and 9 during 1992 indicate TCE concentrations are similar to historical water quality data collected from 1985 to 1991.

The results from the analysis of groundwater samples collected from Wells 11 and 13 during 1985 through 1992 show considerable variability. The TCE concentration of groundwater samples collected from Well 11 range from below the laboratory detection limit (May 1990) to 520 µg/L (December 1985). The TCE concentration of groundwater samples collected from Well 13 range from less than the laboratory reporting limit (April 1991) to 140 µg/L (April 1987).

Carimona Member Well 13 and Magnolia Member Well ZZ are part of a well nest located at the intersection of 21st Avenue Southeast and Fairmont. The vertical gradient in this vicinity is upwards from the Magnolia Member to the Carimona Member of the Platteville Formation. The groundwater quality in the vicinity of Carimona Member Well 13 may be adversely impacted by leakage of Magnolia Member groundwater to the Carimona. The concentration of TCE in the samples of groundwater collected from Magnolia Member Well ZZ are consistently higher than the concentration of TCE in samples collected from Carimona Member Well 13.

The potentiometric data (Figure 9) collected prior to start-up of the Magnolia pump-out system indicate that, in general, the water levels in the Carimona wells are uniform. The water level measured in Well 108 is likely not representative of water levels in the aquifer near the well due to frictional well losses. The water level in Well SS is significantly lower than the other monitoring wells. This may be due to leakage from the Carimona Member into the Magnolia Member.

Following shut down of Well 108 and start-up of Magnolia Pump-out Wells MG1 and MG2, water levels in the Carimona monitoring wells were generally comparable to those measured in May 1992. Water levels in Wells 12 and SS were lower due to relatively high leakage rates into the Magnolia Member in the vicinity of these wells. Details on the effect of the Magnolia Pump-out Wells on water levels in the Carimona Member are presented in Section 4.1 of this report.

5.3 Magnolia Member of Platteville Formation

The results from the analysis of groundwater samples collected from Magnolia Member wells during 1992 indicate the TCE and total VOC concentrations ranged from 3.1 µg/L (Well OO) to 96 µg/L (Well ZZ), as shown in Table 8. The highest concentration of TCE was reported for the groundwater sample collected from Magnolia Member Well ZZ. This well is located upgradient of the former disposal area, and appears to be adversely impacted by an unknown contaminant source located to the southeast of the site.

The results from the analysis of groundwater samples collected from the Magnolia Member monitoring wells during 1992 indicate TCE concentrations are similar to historical water quality data compiled from 1985 to 1991.

The May 1992 potentiometric surface elevation data indicate the direction of groundwater flow in the Magnolia Member was to the northwest prior to start-up of the pump-out system. Following start-up of the pump-out system, groundwater flow converges toward the pump-out wells. The hydraulic gradient between Well VV and Well MG1 is 0.03 ft/ft. Water levels from Pump-out Wells MG1 and MG2 indicate these wells are highly efficient.

Over the long term, groundwater levels in the Magnolia Member are expected to seasonally fluctuate 0.6 feet to 1.0 feet. The hydraulic gradient between the Carimona Member and the Magnolia Member affected by the fluctuation indicates that leakage is maintained from the Carimona Member into the Magnolia Member.

5.4 St. Peter Sandstone

The results from the analysis of groundwater samples collected from St. Peter Wells 201, 202, and 203 during 1992 indicate TCE concentrations were either trace or not detected. The average concentration of TCE detected in samples collected from Well 200 during 1992 equaled approximately 63 $\mu\text{g}/\text{L}$, as previously shown in Table 9. The results from the analysis of groundwater samples collected from Wells 200, 201, 202, and 203 during 1992 indicate TCE concentrations are similar to historical water quality data compiled from 1985 to 1991.

The 1992 potentiometric surface elevation data indicate the general direction of groundwater flow in the St. Peter Sandstone is to the southwest. The 1992 data is consistent with the potentiometric surface elevation data collected during prior monitoring years.

5.5 Prairie du Chien/Jordan

The results from the analysis of groundwater samples collected from the Henkel well during 1992 indicate the TCE concentrations ranged from not detected to 31 $\mu\text{g}/\text{L}$, as previously shown in Table 10. The VOC concentrations ranged from 3.4 to 31 $\mu\text{g}/\text{L}$. The results from the analysis of groundwater samples collected from the Henkel well indicate TCE concentrations are within the range of historical water quality data compiled from 1985 to 1991.

5.6 Downgradient Pump-Out System

The average concentration of TCE reported for samples collected from the downgradient pump-out system discharge was 86 $\mu\text{g}/\text{L}$, and the average total concentration of VOCs was 87 $\mu\text{g}/\text{L}$, as previously shown in Table 12. The highest concentration of TCE reported during 1992 was 110 $\mu\text{g}/\text{L}$, as was the highest concentration of total VOCs reported. The results from the analysis of discharge samples collected during 1992 indicate the TCE concentrations are similar to historical water quality data compiled from 1985 to 1991.

The 1992 water quality data also indicate the downgradient pump-out system is effective in containing glacial drift groundwater with a concentration of TCE exceeding 270 $\mu\text{g}/\text{L}$. This is evidenced by the water quality of the two monitoring wells located downgradient of the downgradient glacial drift pump-out system. The 1992 data for Wells V and W indicate the TCE concentrations ranged from 1.3 to 83 $\mu\text{g}/\text{L}$ (Table 6).

5.7 Site Groundwater Pump-Out Systems

The results from the analysis of samples collected quarterly from the site glacial drift pump-out system indicate the average influent concentration of TCE was 360 $\mu\text{g}/\text{L}$ and the average influent concentration of VOCs was 460 $\mu\text{g}/\text{L}$ (Table 13). The highest concentration of TCE reported in site pump-out system influent samples during 1992 was 450 $\mu\text{g}/\text{L}$. The maximum total concentration of VOCs reported was 710 $\mu\text{g}/\text{L}$, as shown in Table 14. This value was recorded during the second quarter of 1992 when the influent sample was analyzed for priority pollutant organic compounds. The results of influent samples collected during 1992 indicate the concentration of TCE has decreased since start-up of the pump-out system in 1985.

The routine volatile organic data (Table 13) and the volatile fraction priority pollutant data (Table 14) indicate TCE remains the primary volatile organic compound present in the groundwater at the East Hennepin Avenue site. TCE comprises approximately 66 percent of the contaminant matrix based on the 1992 volatile fraction priority pollutant data. The 1992 data also indicate the presence of twelve other VOCs including: 1,1-dichloroethane, 1,2-dichloroethylene, chloroform, 1,2-dichloroethane, 1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, tetrachloroethylene, benzene, toluene, ethyl benzene, xylenes, and acetone. Methylene chloride was also detected, but is a potentially false positive value based on the compound being detected in the method blank. Also included in the analysis for priority pollutant volatile organic compounds was an analysis for tentatively identified volatile organic compounds (TIC). Formamide was detected in the TIC analysis at a concentration of approximately 5.6 $\mu\text{g}/\text{L}$.

The Magnolia Member pump-out system effluent was sampled on November 3, 1992 (4th quarter), following system start-up in September. The results from analysis of the sample indicate a TCE and total VOC concentration of 32 $\mu\text{g}/\text{L}$ (Table 15).

5.8 Site Groundwater Treatment System

The results from the analysis of samples collected from the treatment system effluent indicate the average TCE concentration was 17 $\mu\text{g}/\text{L}$, and the average total VOC concentration was 19 $\mu\text{g}/\text{L}$. The maximum TCE and maximum total VOC concentration reported was 28 $\mu\text{g}/\text{L}$ and 33 $\mu\text{g}/\text{L}$, respectively. The treatment system removal efficiency was between 98 and 100 percent during the first two quarters of 1992, but dropped to 96 and 94 percent during the third and fourth quarter sampling events, respectively. This places the annual average percent removal efficiency at 97 percent. The suspected cause of the decreased removal efficiency is calcium carbonate and iron precipitate build-up on the stripper tower packing material. Replacement of the packing material is scheduled for January 1993.

6.0 SUMMARY AND CONCLUSIONS

6.1 Glacial Drift

Water quality and water level data indicate continued containment of groundwater with a concentration of TCE exceeding 270 $\mu\text{g}/\text{L}$ in the glacial drift aquifer by the site glacial drift and downgradient glacial drift pump-out systems.

6.2 Carimona Member

The Carimona Member acts as a leaky confining layer above the Magnolia Member. A variable hydraulic connection exists between the Carimona Member and Magnolia Member. The Magnolia Member Pump-out Wells have a greater influence on the vertical gradient from the Carimona Member to the Magnolia Member than did Carimona Pump-out Well 108. The increased hydraulic gradient causes increased leakage from the Carimona Member into the

Magnolia Member. Due to the effectiveness of Magnolia Member Pump-out Wells MG1 and MG2, pump-out Well 108 is not anticipated to be operated during 1993.

Carimona pump-out Well 108 was shut down in September of 1992 following start-up of the Magnolia site pump-out system. Carimona Pump-out Well 108 was determined to be less effective than Magnolia Pump-out Wells MG1 and MG2. These wells capture the groundwater beneath the site in the Carimona Member.

6.3 Magnolia Member

Magnolia Member water quality and water level data collected from the monitoring network suggests the primary source of TCE in the Magnolia Member originates from a contaminant source located upgradient of the East Hennepin Avenue Site with respect to Magnolia Member groundwater flow directions. Historically, the highest TCE concentrations are consistently found in samples from Magnolia Member wells located upgradient of the site (particularly Well ZZ).

Based on a comparison of the observed groundwater elevations in November 1992 and those predicted by computer modeling (Barr, 1991), Pump-out Wells MG1 and MG2 effectively capture the groundwater flowing beneath the site in the Magnolia Member and a large percentage of the groundwater upgradient of the site as discussed in Section 4.1 of this report.

6.4 St. Peter Sandstone

Water quality data collected from the St. Peter wells indicate the continued presence of VOCs in the St. Peter Sandstone aquifer at concentrations similar to historical water quality data.

6.5 Prairie du Chien/Jordan

Water quality data collected from the Henkel well indicate the continued presence of VOCs at concentrations similar to historical water quality data.

7.0 RECOMMENDATIONS

1. Continued operation of the site pump-out and groundwater treatment systems, and the downgradient glacial drift pump-out systems in accordance with the 1985 Consent Order; the 1985 Groundwater Pump-Out System Plan; the Department of Natural Resources Water Appropriation Permits; and, the 1993 Monitoring Plan (Appendix B).
2. Ongoing inspection and maintenance of the groundwater pump-out and treatment systems.
3. Replacement of stripper tower packing material.
4. Continue submittal of data on quarterly basis, but revise Annual Report to a Bi-annual Report (once every two years).
5. Monitoring of groundwater elevations and groundwater quality in accordance with the Proposed 1993 Monitoring Plan (Appendix C).

Tables

TABLE 1
 1992 GROUNDWATER ELEVATIONS
 GLACIAL DRIFT WELLS
 (elevations in feet/MSL)

	1	3	109 (1)	110 (1)	111 (1)
DATE	-----	-----	-----	-----	-----
05/11/92	841.96	834.19	827.20	829.41	819.34
11/02/92	841.98	834.02	827.67	830.60	820.15
	112 (1)	113 (1)	B	Q	S
DATE	-----	-----	-----	-----	-----
05/11/92	812.17	820.21	843.40	828.80	828.55
11/02/92	815.62	820.43	843.43	828.88	828.09
	T	U	V	W	X
DATE	-----	-----	-----	-----	-----
05/11/92	833.05	836.50	817.77	817.81	823.41
11/02/92	832.61	836.21	817.27	817.44	824.05

(1) Pump-out well.

2,.020

TABLE 2

1992 GROUNDWATER ELEVATIONS
CARIMONA MEMBER WELLS

(elevations in feet/MSL)

	8	9	10	11	12
DATE	-----	-----	-----	-----	-----
05/11/92	828.87	829.02	829.01	828.93	829.26
11/02/92	828.81	828.98	829.03	828.85	827.60
	13	108 (1)	BB	RR	SS
DATE	-----	-----	-----	-----	-----
05/11/92	828.29	805.36	828.93	829.08	826.42
11/02/92	828.23	829.22	828.65	829.01	824.50
	WW	WW			
DATE	-----	-----			
05/11/92	828.92	828.89			
11/02/92	828.93	828.86			

(1) Pump-out well.

2,.020

TABLE 3
 1992 GROUNDWATER ELEVATIONS
 MAGNOLIA MEMBER WELLS
 (elevations in feet/MSL)

	OO	QQ	TT	WW	ZZ
DATE	-----	-----	-----	-----	-----
05/11/92	825.10	824.82	822.63	825.87	829.66
11/02/92	820.27	820.33	817.29	822.01	829.61
	(1) MG1	(1) MG2			
DATE	-----	-----	-----	-----	-----
05/11/92	824.59	823.38			
11/02/92	811.91	812.52			

 (1) Pump-out well.
 2,.020

TABLE 4

1992 GROUNDWATER ELEVATIONS
ST. PETER SANDSTONE WELLS

(elevations in feet/MSL)

	200	201	202	203
DATE				
05/11/92	762.57	778.37	754.73	754.01
11/02/92	763.44	780.11	754.93	754.23
	-----	-----	-----	-----
	2,.020			

TABLE 5
GROUNDWATER MONITORING SYSTEM
1992 WATER QUALITY ANALYTICAL PARAMETERS

Chlorinated Volatile Organic Compounds

1,1-Dichloroethane

1,2-Dichloroethane

1,2-Dichloroethylene, cis

1,2-Dichloroethylene, trans

1,1,2,2-Tetrachloroethane

Tetrachloroethylene

1,1,1-Trichloroethane

Trichloroethene

TABLE 6
1992 WATER QUALITY DATA
GLACIAL DRIFT WELLS
(concentrations in ug/L)

	B 05/12/92	Q 05/13/92	S 05/12/92	T 11/03/92	U 05/13/92	V 05/12/92	W 05/13/92	X 11/03/92	Y 05/13/92	Z 05/12/92	1 05/12/92	2 11/03/92	3 05/12/92	4 11/03/92
1,1-Dichloroethane	2.0	<1.0	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0	2.4	--	--
1,2-Dichloroethylene, cis	7.6	<1.0	16	--	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0	--	--	--
1,2-Dichloroethylene, trans	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0	--	--	--
1,2-Dichloroethane	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0	--	--	--
1,1,2,2-Tetrachloroethane	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0	--	--	--
Tetrachloroethylene	6.0	<1.0	2.6	--	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0	--	--	--
1,1,1-Trichloroethane	2.5	3.2	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	<1.0	<1.0	--	--	--
Trichloroethylene	510	<1.0	510	770	<1.0	<1.0	<1.0	--	<1.0	63	83	--	--	--
Sum Volatile Organics	530	3.2	530	770	ND	ND	ND	ND	ND	65	83	--	--	--
W			X		Y		Z		1		2		3	
	05/13/92	11/03/92		05/13/92	05/12/92	11/03/92		05/12/92	05/12/92	11/03/92		05/12/92	11/03/92	
1,1-Dichloroethane	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	--	3.8	--	25	--	--	--
1,2-Dichloroethylene, cis	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	--	1.0	--	1.0	--	--	--
1,2-Dichloroethylene, trans	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	--	<1.0	--	<1.0	--	--	--
1,2-Dichloroethane	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	--	<1.0	--	<1.0	--	--	--
1,1,2,2-Tetrachloroethane	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	--	<1.0	--	<1.0	--	--	--
Tetrachloroethylene	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	--	2.8	--	1.4	--	--	--
1,1,1-Trichloroethane	<1.0	--	<1.0	<1.0	<1.0	--	<1.0	--	400	--	430	--	--	--
Trichloroethylene	5.9	1.3	<1.0	2.2	0.5	--	2.2	0.5	170	--	170	--	--	--
Sum Volatile Organics	5.9	1.3	ND	2.2	0.5	--	2.2	0.5	430	--	430	--	--	--

-- Not analyzed.

ND Not Detected.

.016
12/02/92

TABLE 7
1992 WATER QUALITY DATA
CARIMONA MEMBER WELLS
(concentrations in ug/L)

	BB 05/13/92	RR 05/12/92	SS 05/13/92	WW 05/13/92	MM 05/12/92	S 05/15/92
1,1-Dichloroethane	6.9	<1.0	7.0	<1.0	2.8	<1.0
1,2-Dichloroethylene, cis	98	16	<1.0	3.1	72	1.4
1,2-Dichloroethylene, trans	1.8	<1.0	<1.0	<1.0	2.1	<1.0
1,2-Dichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethylene	9.9	<1.0	<1.0	<1.0	5.5	<1.0
1,1,1-Trichloroethane	3.1	<1.0	<1.0	<1.0	2.4	<1.0
Trichloroethylene	870	90	2.2	23	700	47
Sum Volatile Organics	990	110	9.2	26	790	48
	9 05/14/92		10 05/15/92		11 05/12/92	
1,1-Dichloroethane	<1.0	--	<1.0	--	<1.0	--
1,2-Dichloroethylene, cis	<1.0	--	1.2	--	6.7	--
1,2-Dichloroethylene, trans	<1.0	--	<1.0	--	<1.0	--
1,2-Dichloroethane	1.8	--	<1.0	--	<1.0	--
1,1,2,2-Tetrachloroethane	<1.0	--	<1.0	--	<1.0	--
Tetrachloroethylene	<1.0	--	<1.0	--	<1.0	--
1,1,1-Trichloroethane	<1.0	--	<1.0	--	<1.0	--
Trichloroethylene	3.2	2.4	58	59	190	66
Sum Volatile Organics	5.0	2.4	59	59	200	66
	12 05/14/92		13 05/12/92		108 05/14/92	
1,1-Dichloroethane	<1.0	--	<1.0	--	3.1	
1,2-Dichloroethylene, cis	<1.0	--	1.3	--	61	
1,2-Dichloroethylene, trans	<1.0	--	<1.0	--	2.3	
1,2-Dichloroethane	<1.0	--	<1.0	--	<1.0	
1,1,2,2-Tetrachloroethane	<1.0	--	<1.0	--	<1.0	
Tetrachloroethylene	<1.0	--	<1.0	--	3.5	
1,1,1-Trichloroethane	<1.0	--	<1.0	--	1.7	
Trichloroethylene	<1.0	<0.5	71	--	380	
Sum Volatile Organics	ND	ND	72	--	450	

-- Not analyzed.
ND Not Detected.

.016
12/02/92

TABLE 8

1992 WATER QUALITY DATA
MAGNOLIA MEMBER WELLS

(concentrations in ug/L)

	OO	QQ	TT	
	05/13/92	11/04/92	06/01/92	05/13/92
				11/05/92
1,1-Dichloroethane	<1.0	--	<1.0	<1.0
1,2-Dichloroethylene, cis	<1.0	--	<1.0	7.2
1,2-Dichloroethylene, trans	<1.0	--	<1.0	<1.0
1,2-Dichloroethane	<1.0	--	<1.0	<1.0
1,1,2,2-Tetrachloroethane	<1.0	--	<1.0	<1.0
Tetrachloroethylene	<1.0	--	<1.0	<1.0
1,1,1-Trichloroethane	<1.0	--	<1.0	<1.0
Trichloroethylene	3.1	17	4.7	58
Sum Volatile Organics	3.1	17	4.7	6.4
 VV ZZ				
	05/13/92	11/05/92	05/14/92	11/05/92
1,1-Dichloroethane	<1.0	--	<1.0	--
1,2-Dichloroethylene, cis	5.8	--	3.7	--
1,2-Dichloroethylene, trans	<1.0	--	<1.0	--
1,2-Dichloroethane	<1.0	--	<1.0	--
1,1,2,2-Tetrachloroethane	<1.0	--	<1.0	--
Tetrachloroethylene	<1.0	--	<1.0	--
1,1,1-Trichloroethane	<1.0	--	<1.0	--
Trichloroethylene	60	29	88	96
Sum Volatile Organics	66	29	92	96

-- Not analyzed.

.016
12/02/92

TABLE 9

1992 WATER QUALITY DATA
ST. PETER SANDSTONE WELLS

(concentrations in ug/L)

	200	201	202	203
	05/15/92	11/04/92	05/14/92	05/14/92
1,1-Dichloroethane	<1.0	--	<1.0	<1.0
1,2-Dichloroethylene, cis	5.9	--	<1.0	<1.0
1,2-Dichloroethylene, trans	<1.0	--	<1.0	<1.0
1,2-Dichloroethane	<1.0	--	<1.0	<1.0
1,1,2,2-Tetrachloroethane	<1.0	--	<1.0	<1.0
Tetrachloroethylene	<1.0	--	<1.0	<1.0
1,1,1-Trichloroethane	<1.0	--	<1.0	<1.0
Trichloroethylene	61	64	<1.0	1.2
Sum Volatile Organics	67	64	ND	ND

-- Not analyzed.
ND Not Detected.

.016
12/02/92

TABLE 10

1992 WATER QUALITY DATA
PRAIRE DU CHIEN/JORDAN WELL

(concentrations in ug/L)

	HENKEL	
	05/15/92	11/03/92
1,1-Dichloroethane	<1.0	<0.5
1,2-Dichloroethylene, cis	<1.0	<0.5
1,2-Dichloroethylene, trans	<1.0	<0.5
1,2-Dichloroethane	<1.0	<0.5
1,1,2,2-Tetrachloroethane	<1.0	<0.5
Tetrachloroethylene	<1.0	<0.5
1,1,1-Trichloroethane	<1.0	3.4
Trichloroethylene	31	<0.5
Sum Volatile Organics	31	3.4

-- Not analyzed.

.016
12/02/92

TABLE 11
GROUNDWATER PUMP-OUT AND TREATMENT SYSTEM
1992 WATER QUALITY PARAMETERS

Chlorinated Volatile Organic Compounds

1,1-Dichloroethane
1,2-Dichloroethane
1,2-Dichloroethylene, cis
1,2-Dichloroethylene, trans
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
1,1,1-Trichloroethane
Trichloroethene

Non-Chlorinated Volatile Organic Compounds

Benzene
Toluene
Xylenes

TABLE 12
 1992 WATER QUALITY DATA
 DOWNGRADIENT PUMP-OUT SYSTEM
 (concentrations in ug/L)

	DISCHARGE (1)			
	01/03/92	05/15/92	08/26/92	11/03/92
1,1-Dichloroethane	--	<1.0	--	<0.5
1,2-Dichloroethylene, cis	--	3.4	--	<0.5
1,2-Dichloroethylene, trans	--	<1.0	--	<0.5
1,2-Dichloroethane	--	<1.0	--	<0.5
1,1,2,2-Tetrachloroethane	--	<1.0	--	<0.5
Tetrachloroethylene	--	<1.0	--	<0.5
1,1,1-Trichloroethane	--	1.2	--	0.8
Trichloroethylene	99	55	78	110
Benzene	--	<1.0	--	<0.5
Toluene	--	<1.0	--	<0.5
Xylenes	--	<1.0	--	<0.5
Sum Volatile Organics	99	60	78	110

(1) Pump-out well 111, 112, 113.
 -- Not analyzed.

.016
 12/02/92

TABLE 13
 1992 WATER QUALITY DATA
 SITE PUMP-OUT AND TREATMENT SYSTEMS
 (concentrations in ug/L)

	INFLUENT (1)			
	01/03/92	05/14/92	08/26/92	11/03/92
1,1-Dichloroethane	--	<1.0	--	<0.5
1,2-Dichloroethylene, cis	--	48	--	80
1,2-Dichloroethylene, trans	--	<1.0	--	<0.5
1,2-Dichloroethane	--	2.4	--	<0.5
1,1,2,2-Tetrachloroethane	--	<1.0	--	<0.5
Tetrachloroethylene	--	4.6	--	<0.5
1,1,1-Trichloroethane	--	5.4	--	2.2
Trichloroethylene	260	320	420	450
Benzene	--	<1.0	--	8.3
Toluene	--	140	--	29
Xylenes	--	36	--	6.6
Sum Volatile Organics	260	560	420	580
	EFFLUENT (2)			
	01/03/92	05/14/92	08/26/92	11/03/92
1,1-Dichloroethane	--	<1.0	--	<0.5
1,2-Dichloroethylene, cis	--	1.6	--	3.6
1,2-Dichloroethylene, trans	--	<1.0	--	<0.5
1,2-Dichloroethane	--	<1.0	--	<0.5
1,1,2,2-Tetrachloroethane	--	<1.0	--	<0.5
Tetrachloroethylene	--	<1.0	--	<0.5
1,1,1-Trichloroethane	--	<1.0	--	<0.5
Trichloroethylene	<1.0	8.3	15	28
Benzene	--	<1.0	--	0.6
Toluene	--	<1.0	--	1.2
Xylenes	--	<1.0	--	<0.5
Sum Volatile Organics	<1.0	9.9	15	33

(1) Pump-out wells 108, 109, 110.

(2) Effluent from groundwater treatment system.

-- Not analyzed.

.016
 12/02/92

TABLE 14

WATER QUALITY DATA
PRIORITY POLLUTANT VOLATILE ORGANIC ANALYSIS
EPA METHOD 624
MAY 14, 1992

(concentrations in ug/L)

	(1) INFLUENT	BLANK
	----- 05/14/92	----- 05/14/92
Chloromethane	<10	<10
Bromomethane	<10	<10
Vinyl Chloride	<10	<10
Chloroethane	<10	<10
Methylene Chloride	2 b(j)	1 j
Acetone	15	<10
Carbodisulfide	5	5
Trichlorofluoromethane	5	5
1,1-Dichloroethylene	5	5
1,1-Dichloroethane	5	5
1,2-Dichloroethylene	76	5
Chloroform	8	5
1,2-Dichloroethane	3 j	5
Methyl Ethyl Ketone	<10	<10
1,1,1-Trichloroethane	5	5
Carbon Tetrachloride	5	5
Vinyl Acetate (Vinyl Ester)	<10	<10
Bromodichloromethane	5	5
1,2-Dichloropropane	5	5
Cis-1,3-Dichloro-1-propene	5	5
Trichloroethylene	470	2 j
Chlorodibromomethane	5	5
1,1,2-Trichloroethane	5	5
Benzene	28	5
Trans-1,3-Dichloro-1-propene	5	5
2-Chloroethylvinyl Ether	<10	<10
Bromoform	5	5
2-Hexanone	<10	<10
Methyl Isobutyl Ketone	<10	<10
Tetrachloroethylene	6	5
1,1,2,2-Tetrachloroethane	2 j	5
Toluene	70	5
Chlorobenzene	5	5
Ethyl Benzene	2 j	5
Styrene	5	5
Xylenes	22	5
1,3-Dichlorobenzene	5	5
1,4-Dichlorobenzene	5	5
1,2-Dichlorobenzene	5	5
Sum Volatile Organics	710	3

-- Not analyzed.

b Potential false positive based on data validation procedures.

j Reported value is less than the detection limit.

(1) Flow rate weighted composite sample (Pump-out wells 108, 109, 110).

12/02/92

.016

TABLE 15

1992 WATER QUALITY DATA
MAGNOLIA PUMP-OUT SYSTEM

(concentrations in ug/L)

(1) MG EFFLUENT	

11/03/92	
Sample	
1,1-Dichloroethane	<0.5
1,2-Dichloroethylene, cis	<0.5
1,2-Dichloroethylene, trans	<0.5
1,2-Dichloroethane	<0.5
1,1,2,2-Tetrachloroethane	<0.5
Tetrachloroethylene	<0.5
1,1,1-Trichloroethane	<0.5
Trichloroethylene	32
Benzene	<0.5
Toluene	<0.5
Xylenes	<0.5
Sum Volatile Organics	32

(1) Pump-out wells MG1 and MG2.
.017

TABLE 16

PUMP-OUT WELLS
1992 PUMPING RATES

	GLACIAL DRIFT PUMP-OUT WELL AVERAGE PUMPING RATE (GPM)					CARIMONA PUMP-OUT WELL AVERAGE PUMPING RATE (GPM)	MAGNOLIA PUMP-OUT WELL AVERAGE PUMPING RATE (GPM)	
	109	110	111	112	113	108	MG1	MG2
Jan 1992	46	52	93	113	90	0 ¹	--	--
Feb 1992	18 ²	52	93	113	90	1.1	--	--
Mar 1992	30	50	94	114	90	13	--	--
Apr 1992	40	49	94	115	83	12	--	--
May 1992	48 ³	49	94	117	69	12	--	--
Jun 1992	46	49	94	118	59	12	--	--
Jul 1992	45	48	95	119	53	12	--	--
Aug 1992	48	50 ⁴	95	120	47	12	--	--
Sep 1992	45	49 ^{4,6}	95	120	44	12 ⁵	97	96
Oct 1992	48	45	60 ⁸	122	29 ⁸	-	74	97
Nov 1992	60 ⁹	34	93	120	89	-	90	97
Dec 1992	60	29	93	116	88	-	90 ⁴	97
Annual Avg. Pumping Rate (gpm)	45 ⁷	46 ⁷	91 ⁷	117 ⁷	69 ⁷	9 ⁷	85 ⁷	97 ⁷

¹ Flow meter not registering due to low flow rate.² Reduced flow rate due to bacterial growth.³ Well down for one day for treatment of bacterial growth and redevelopment.⁴ Flow meter malfunction, estimated flow rate.⁵ Well shut down September 23, 1992 due to start-up of Magnolia wells.⁶ Flow meter from well #108 installed.⁷ Average pumping rate calculated only for period when well was in operation.⁸ Well riser pipe replaced.

-- Not operational.

TABLE 17
PUMP-OUT WELLS
1992 OPERATION DOWNTIME

	GLACIAL DRIFT PUMP-OUT WELL DOWNTIME (DAYS)					CARIMONA PUMP-OUT WELL DOWNTIME (DAYS)	MAGNOLIA PUMP-OUT WELL DOWNTIME (DAYS)	
	109	110	111	112	113	108	MG1	MG2
Jan 1992	0	0	0	0	0	0	--	--
Feb 1992	0	0	0	0	0	0	--	--
Mar 1992	1 ¹	0	0	0	0	0	--	--
Apr 1992	0	0	0	0	0	0	--	--
May 1992	1 ²	0	0	0	0	0	--	--
Jun 1992	0	0	0	0	0	0	--	--
Jul 1992	0	0	0	0	0	0	--	--
Aug 1992	0	0	0	0	0	0	--	--
Sep 1992	0	0	0	0	0	7 ³	0 ⁴	0 ⁴
Oct 1992	0	0	0	0	0	-	0	0
Nov 1992	0	0	0	0	0	-	0	0
Dec 1992	0	0	0	0	0	-	12 ⁵	0
Percent (%) Operating Time	99	100	100	100	100	100 ⁶	100 ⁶	100 ⁶

¹ Well maintenance (cleaning).

² Treatment for bacterial growth.

³ Well shut down due to start-up of Magnolia pump-out wells.

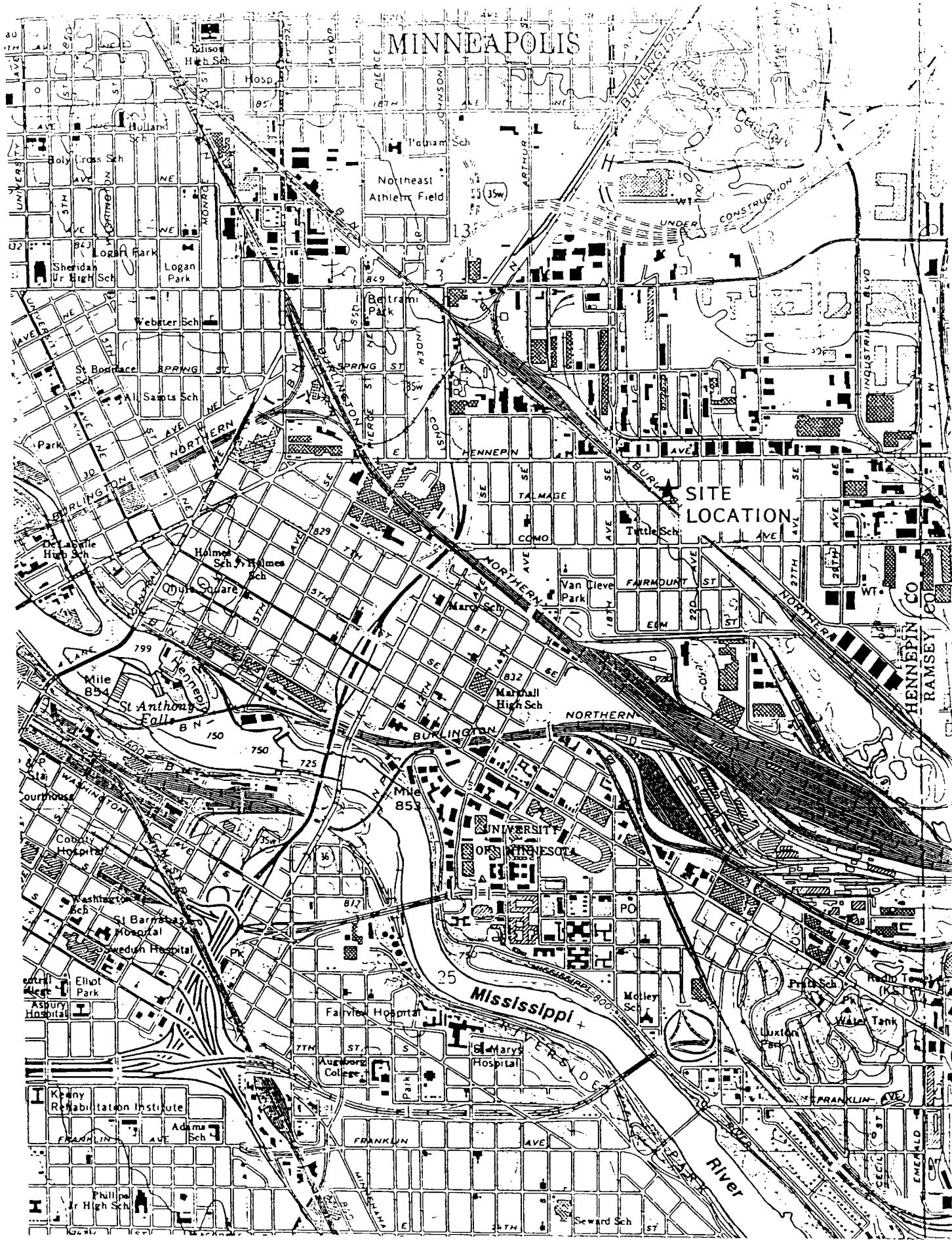
⁴ Well placed in operation on September 23, 1992.

⁵ Well not operating full-time due to flow meter repair.

⁶ Percent operating time calculated only for period when well was in operation.

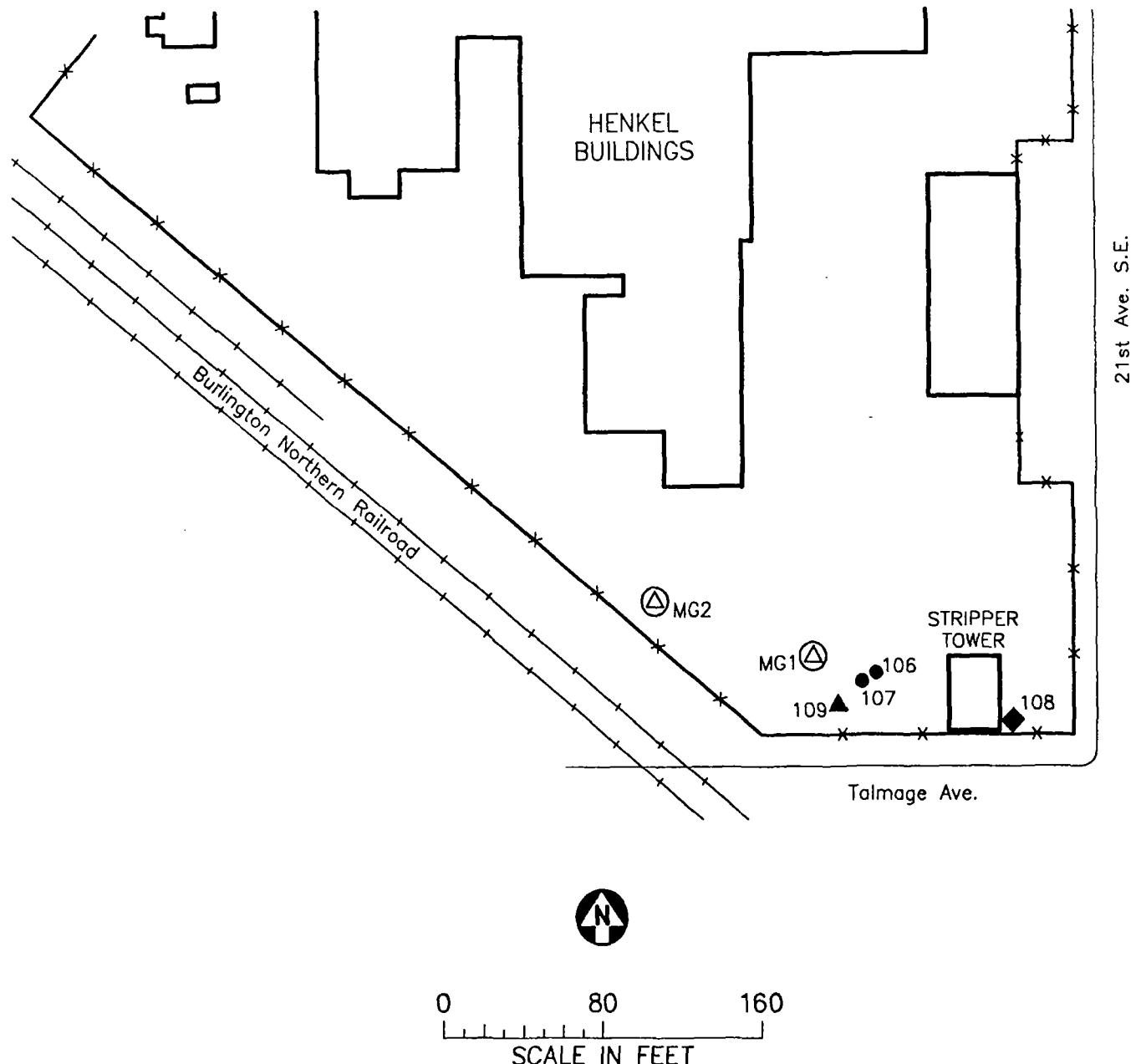
-- Not operational.

Figures



0 NORTH 2000
Scale in Feet

Figure 1
EAST HENNEPIN AVENUE SITE
REGIONAL LOCATION MAP



- ▲ Glacial Drift Pump-Out Well
- ◆ Carimona Member Pump-Out Well
(Shut Down September 1992)
- Ⓐ Magnolia Member Pump-Out Well
- Monitoring Well

JHM SITE MAP 1:0000 01/04/1993 10:48:25

Figure 2

EAST HENNEPIN AVENUE
SITE MAP

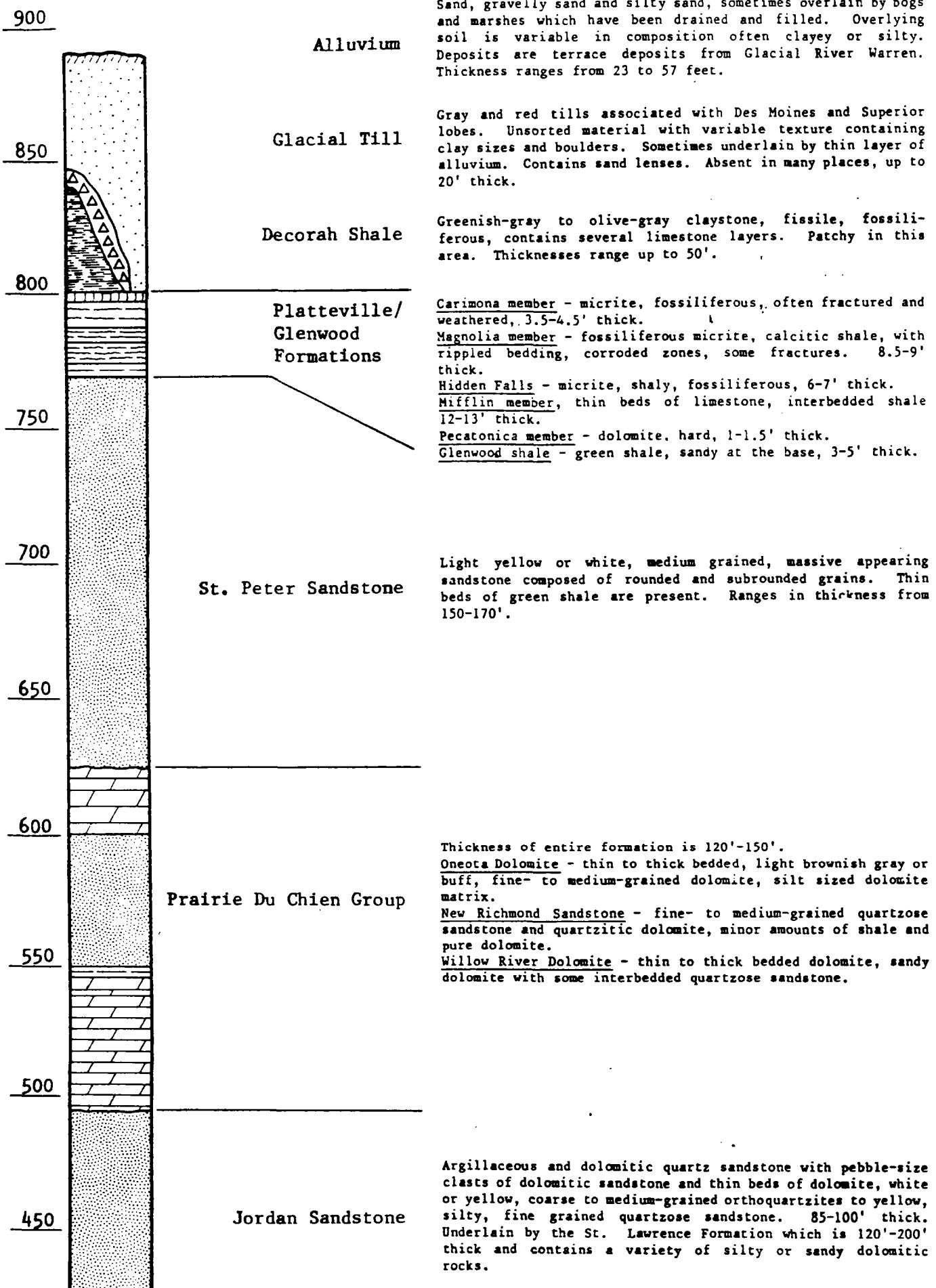


Figure 3
GENERALIZED GEOLOGIC COLUMN

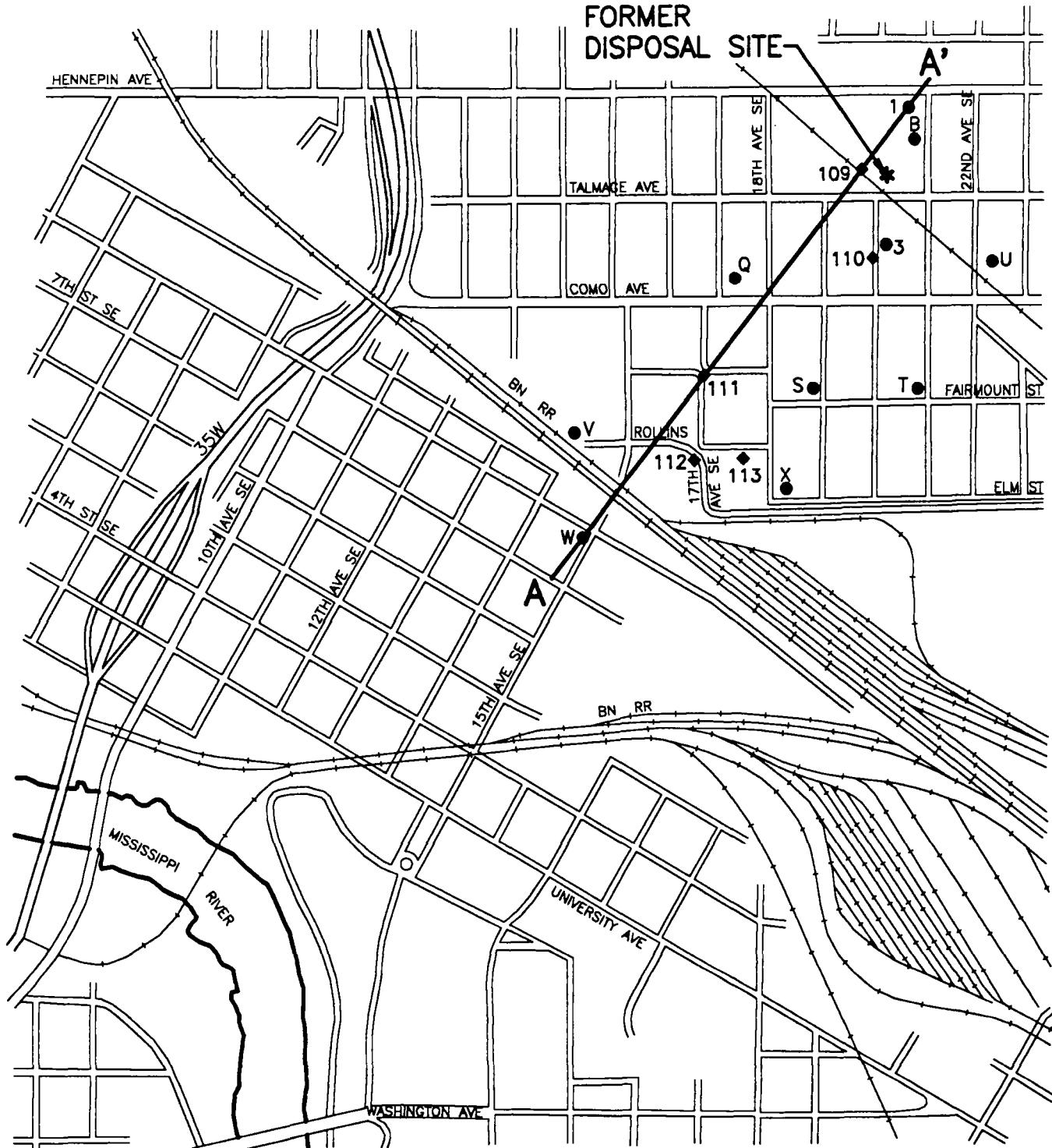
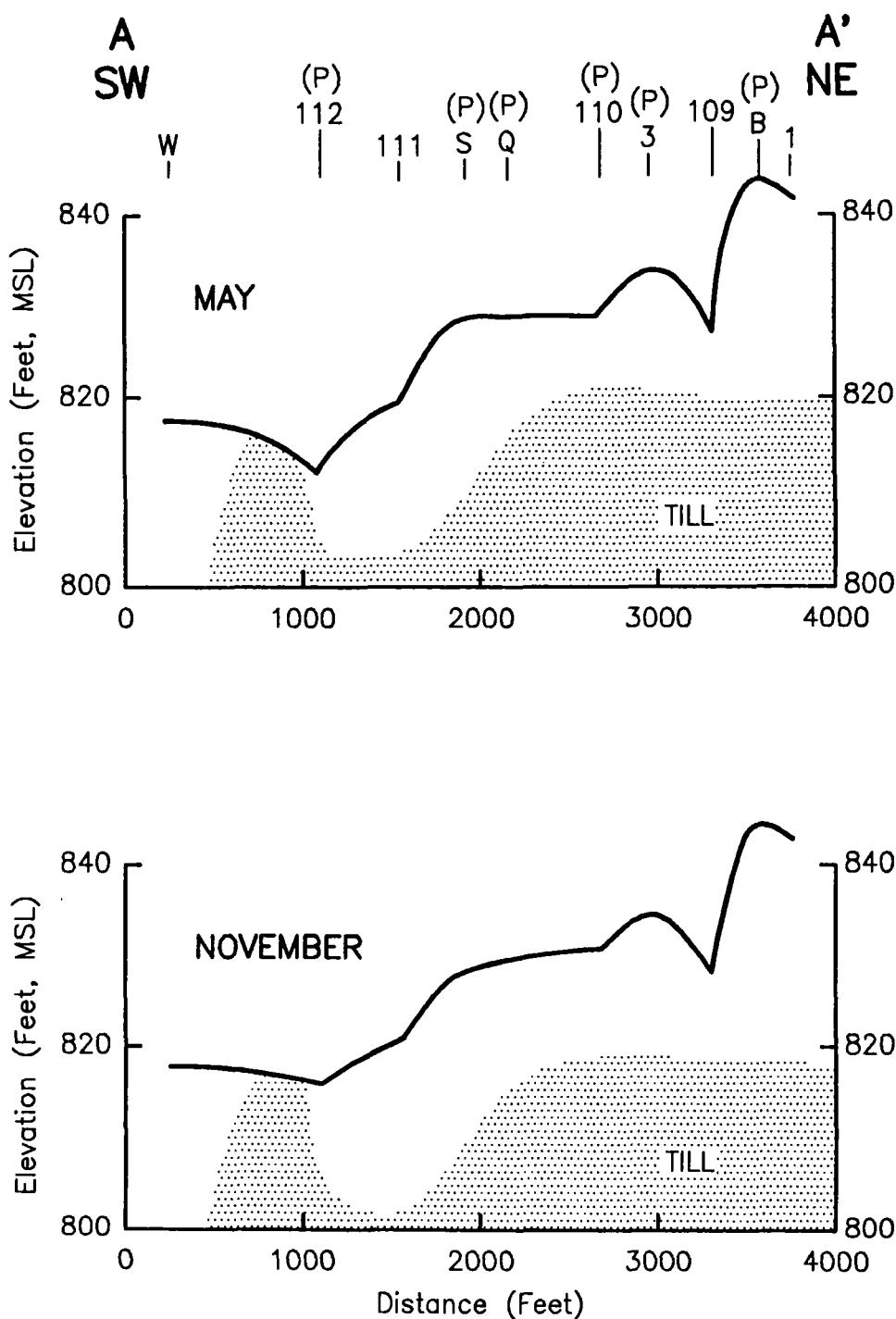
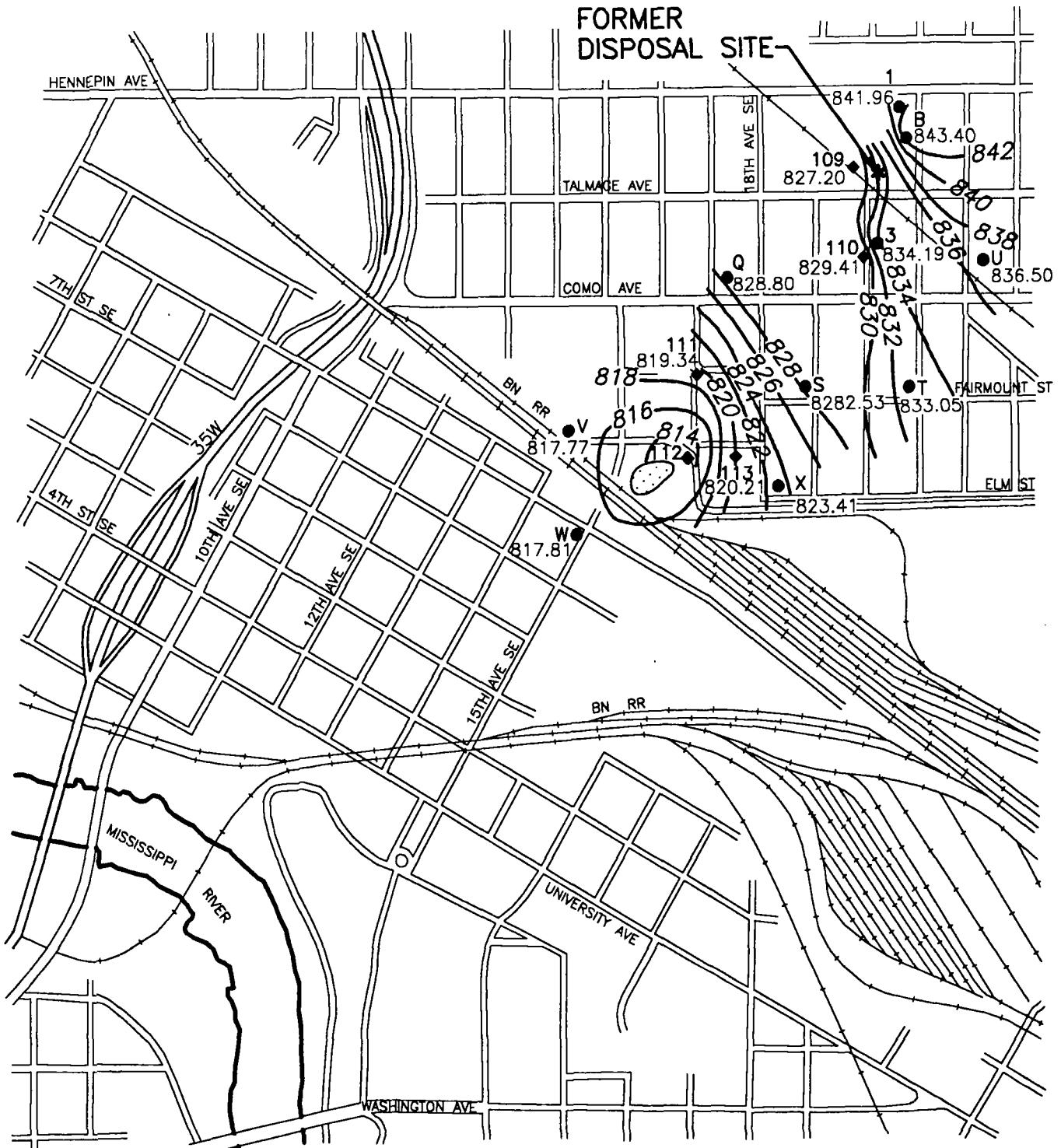


Figure 4
1992 MONITORING LOCATIONS
GLACIAL DRIFT



(P) PROJECTED

Figure 5
CROSS SECTION A-A'
GLACIAL DRIFT WATER TABLE ELEVATIONS
May, November 1992



0 1000
SCALE IN FEET

- GLACIAL DRIFT MONITORING WELL
- ◆ GLACIAL DRIFT PUMP-OUT WELL

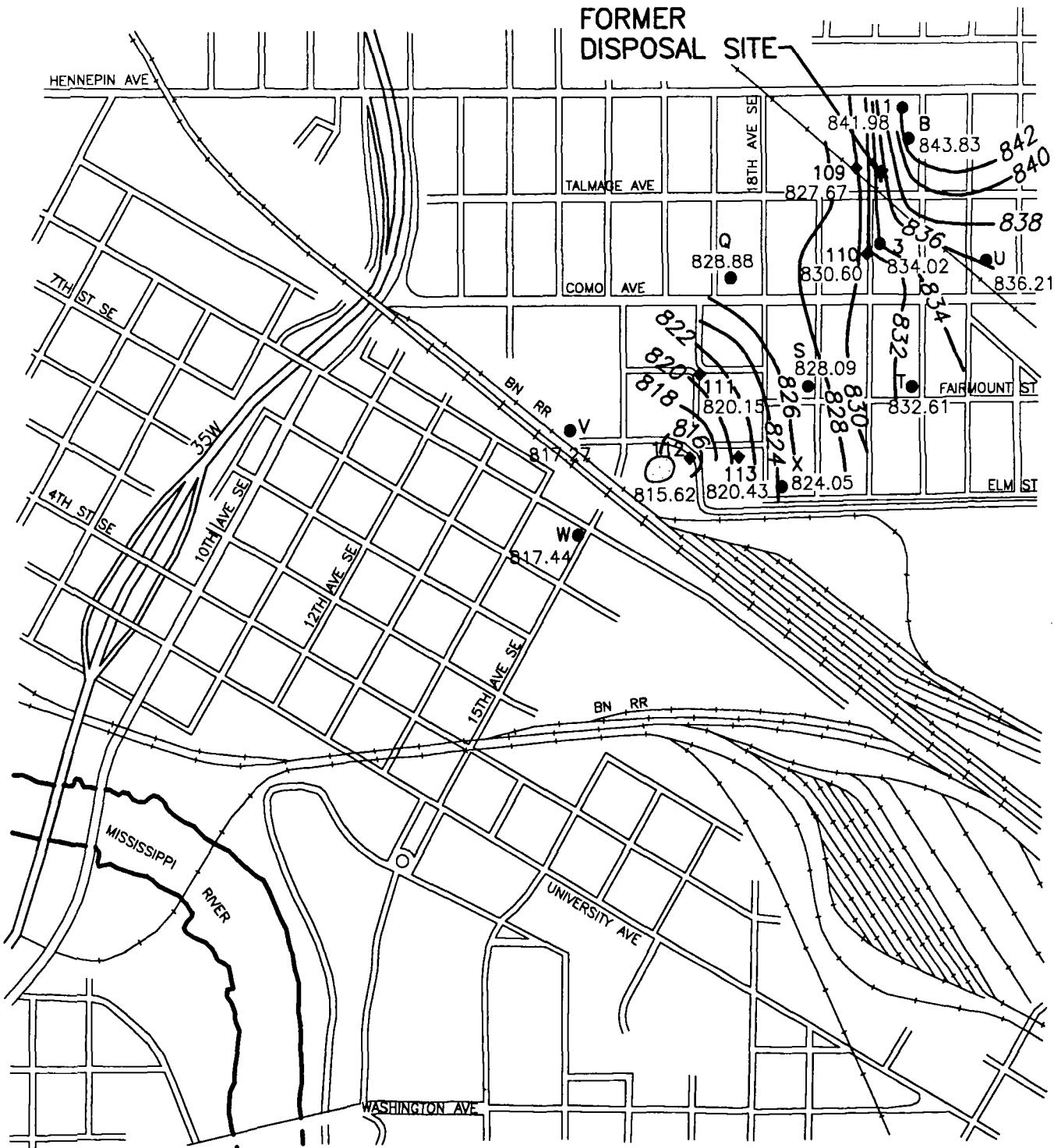
— 828 — GLACIAL DRIFT POTENTIOMETRIC SURFACE ELEVATION (MSL)

817.81 GLACIAL DRIFT POTENTIOMETRIC SURFACE CONTOUR (MSL)

 TILL UNIT EXTENDS ABOVE WATER TABLE

Figure 6

GLACIAL DRIFT AQUIFER
WATER TABLE ELEVATIONS
MAY 1992



- GLACIAL DRIFT MONITORING WELL
- ◆ GLACIAL DRIFT PUMP-OUT WELL

— 828 — GLACIAL DRIFT POTENIOMETRIC SURFACE ELEVATION (MSL)

824.05 GLACIAL DRIFT POTENIOMETRIC SURFACE CONTOUR (MSL)

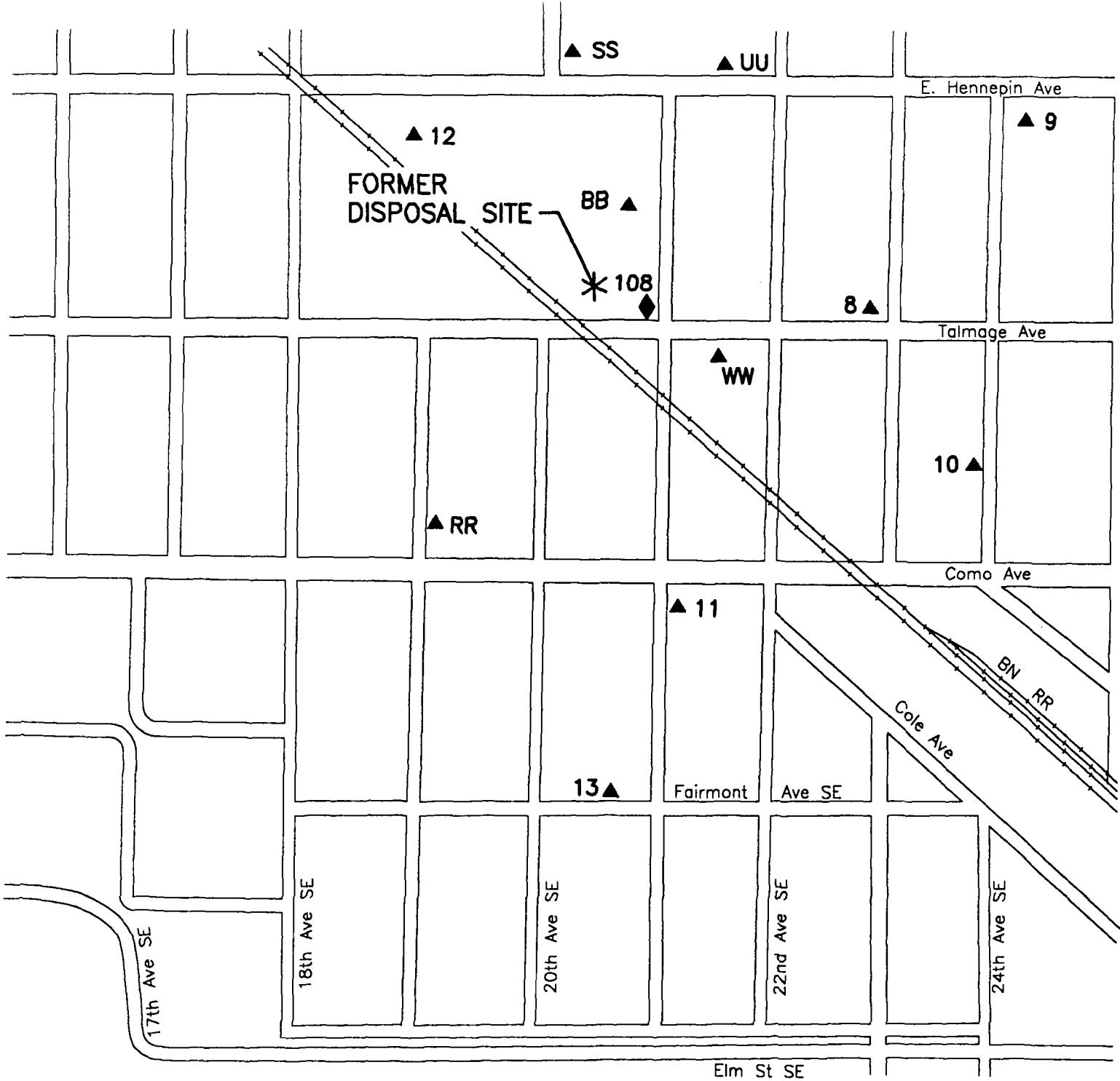
() TILL UNIT EXTENDS ABOVE WATER TABLE



0 1000
SCALE IN FEET

Figure 7

GLACIAL DRIFT AQUIFER
WATER TABLE ELEVATIONS
NOVEMBER 1992



▲ CARIMONA MEMBER MONITORING WELL

◆ CARIMONA MEMBER PUMP-OUT WELL

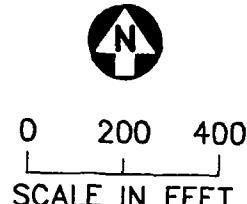
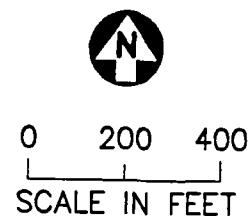
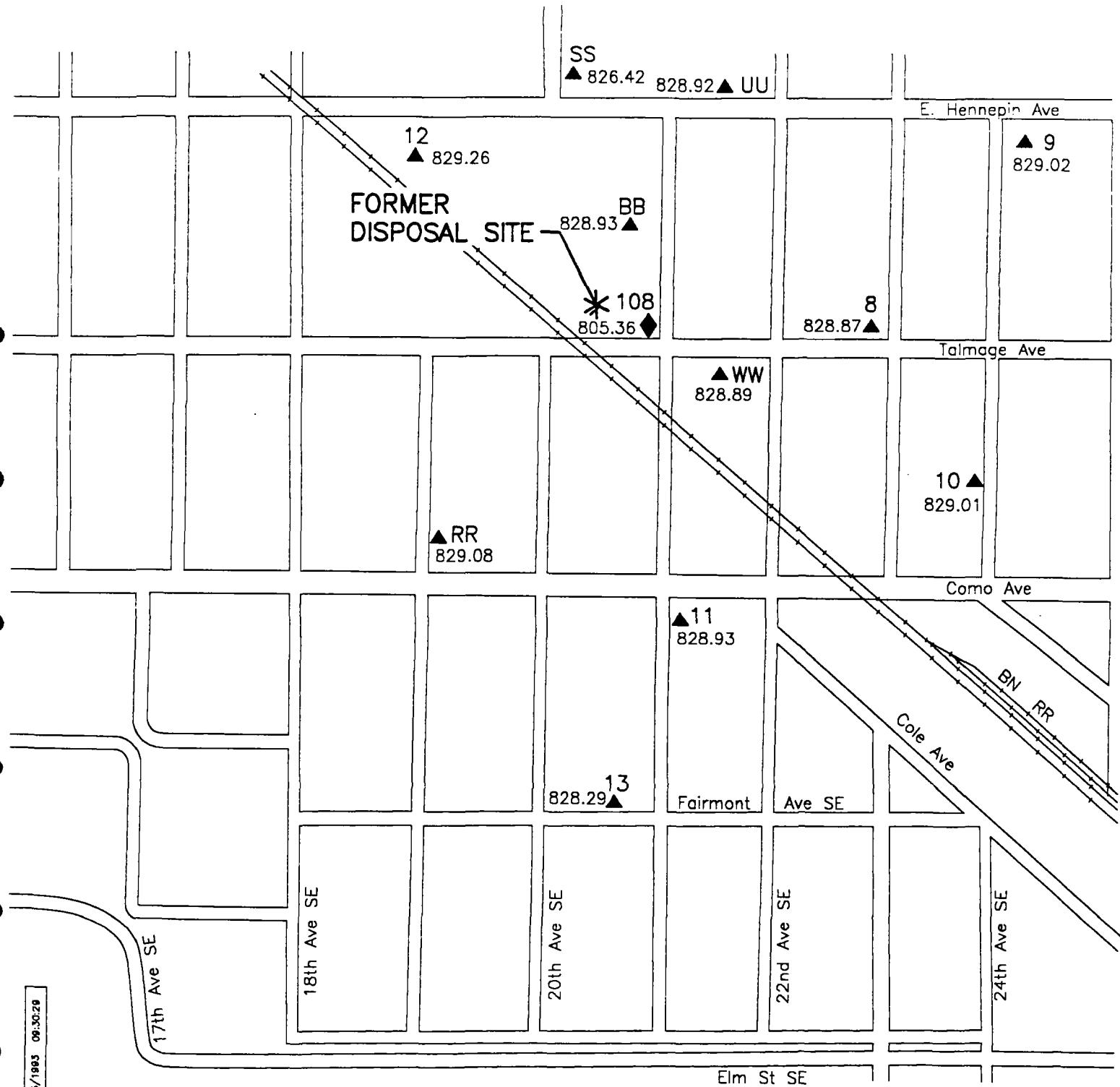
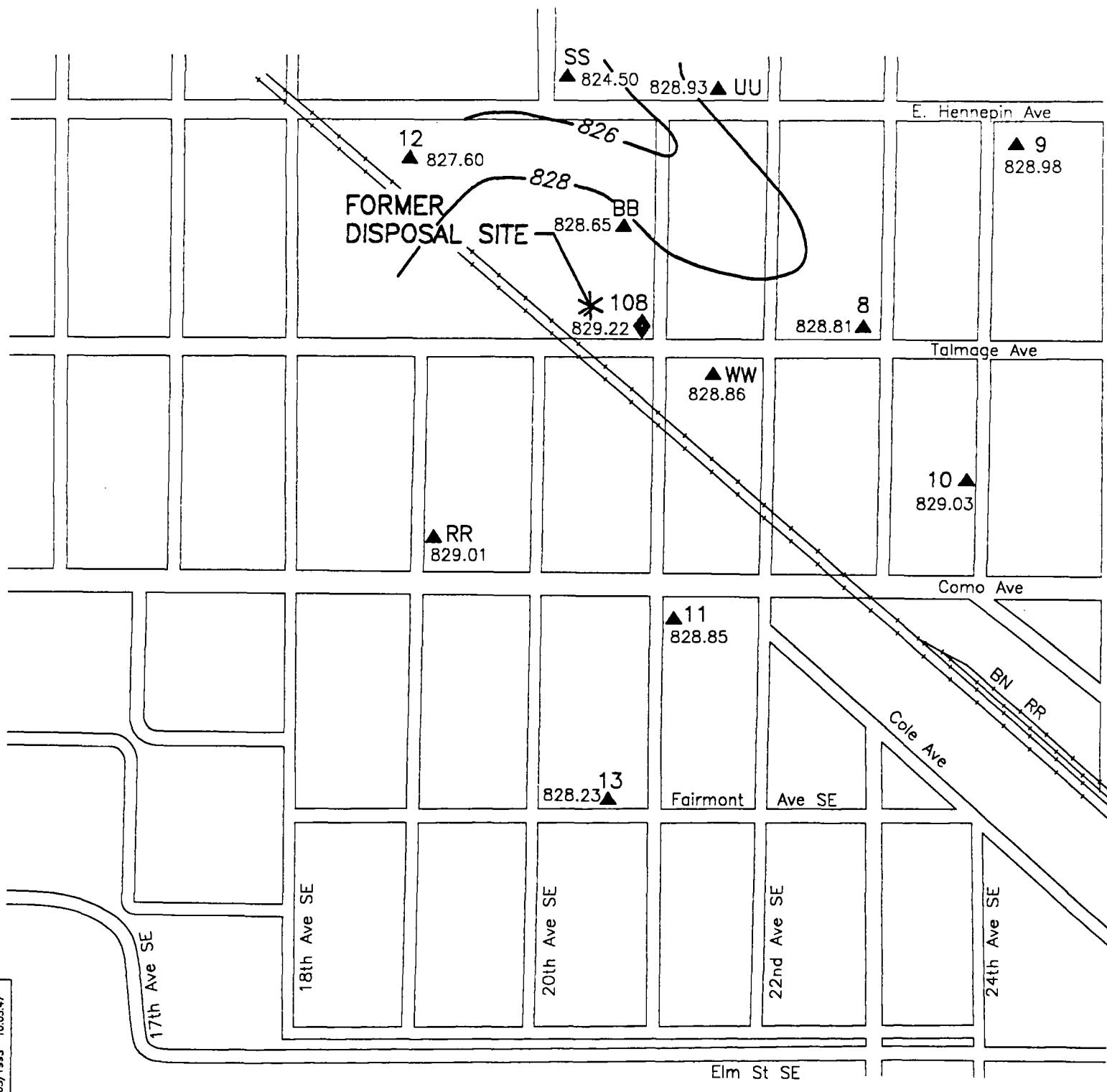


Figure 8
1992 MONITORING LOCATIONS
CARIMONA MEMBER



NOTE: CARIMONA PUMP-OUT WELL 108 OPERATIONAL

Figure 9
CARIMONA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
MAY 1992



CARIMONA MEMBER MONITORING WELL



CARIMONA MEMBER PUMP-OUT WELL

828.23

CARIMONA POTENTIOMETRIC SURFACE ELEVATION (MSL)

— 828 — CARIMONA POTENTIOMETRIC SURFACE CONTOUR (MSL)



0 200 400
SCALE IN FEET

NOTE: CARIMONA PUMP-OUT WELL 108 NOT OPERATIONAL

Figure 10
CARIMONA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
NOVEMBER 1992

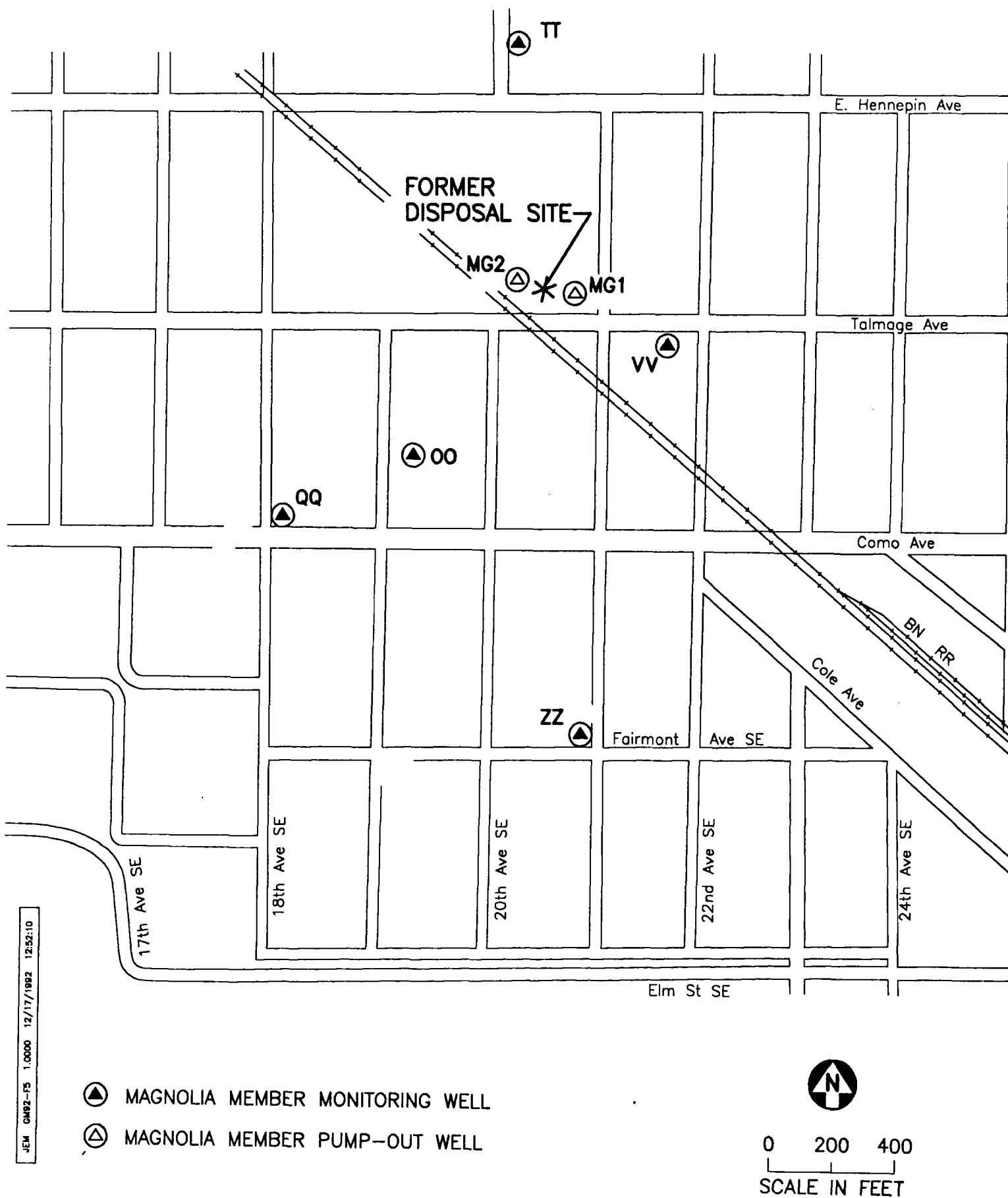
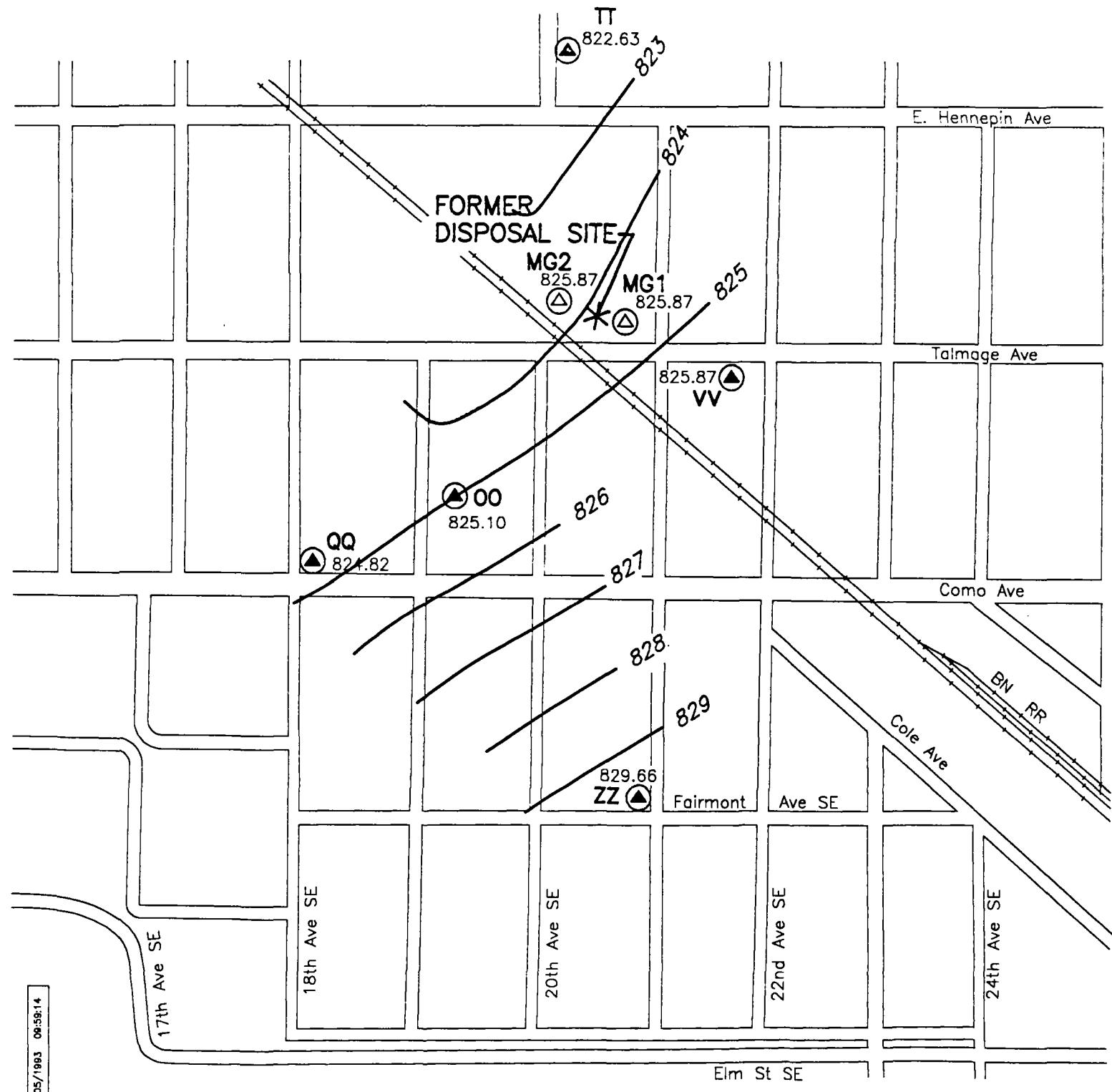


Figure 11
1992 MONITORING LOCATIONS
MAGNOLIA MEMBER



▲ MAGNOLIA MEMBER MONITORING WELL

△ MAGNOLIA MEMBER PUMP-OUT WELL

829.0 MAGNOLIA POTENTIOMETRIC SURFACE ELEVATION (MSL)

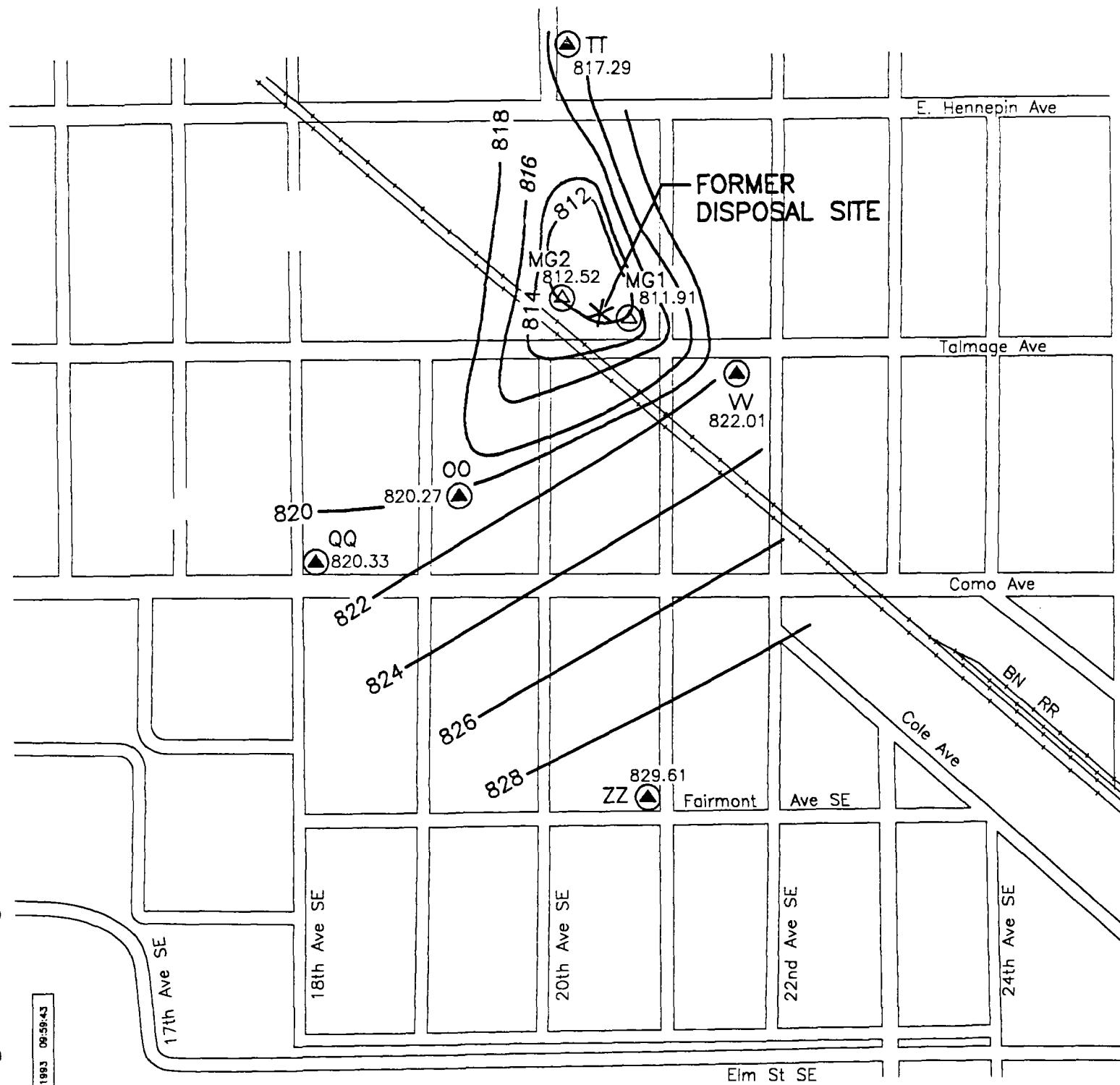
— MAGNOLIA POTENTIOMETRIC SURFACE CONTOUR (MSL)



0 200 400
SCALE IN FEET

NOTE: MAGNOLIA MEMBER PUMP-OUT WELLS MG1 AND MG2 NOT OPERATIONAL

Figure 12
MAGNOLIA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
MAY 1992



▲ MAGNOLIA MEMBER MONITORING WELL

△ MAGNOLIA MEMBER PUMP-OUT WELL

828.0 MAGNOLIA POTENTIOMETRIC SURFACE ELEVATION (MSL)

— MAGNOLIA POTENTIOMETRIC SURFACE CONTOUR (MSL)

0 200 400
SCALE IN FEET

NOTE: MAGNOLIA MEMBER PUMP-OUT WELLS MG1 AND MG2 OPERATIONAL

Figure 13
MAGNOLIA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
NOVEMBER 1992

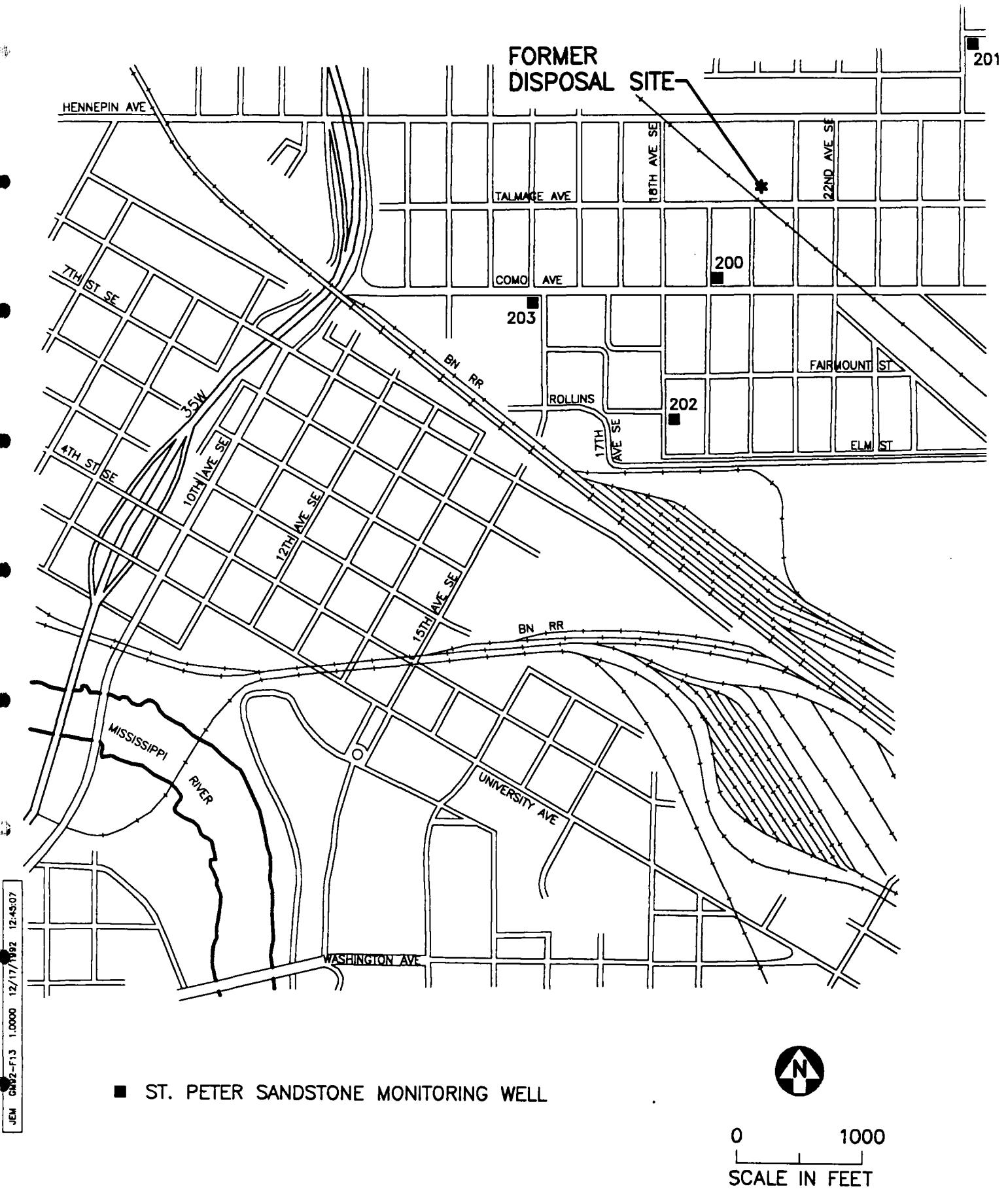
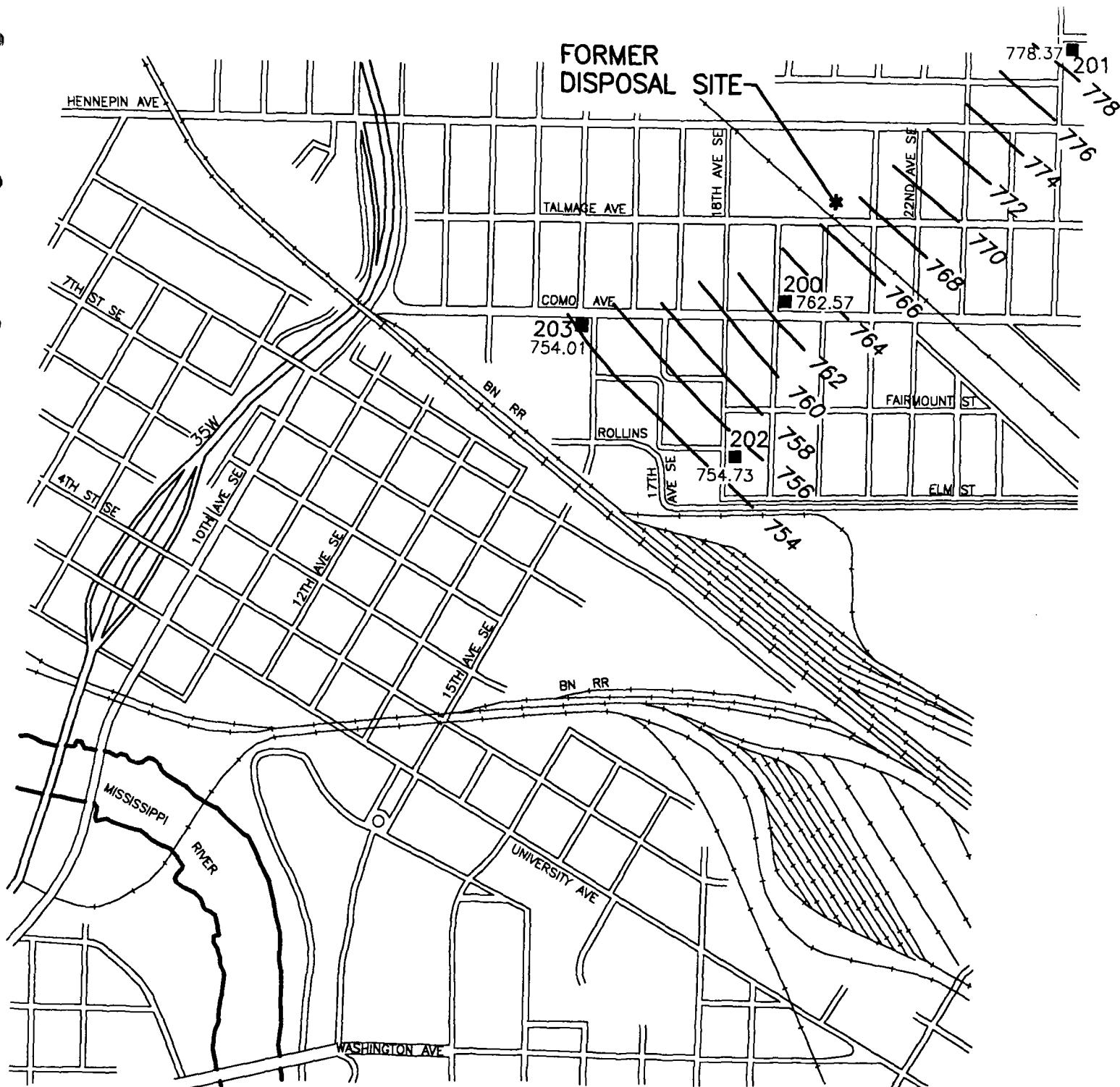


Figure 14
1992 MONITORING LOCATIONS
ST. PETER SANDSTONE



■ ST. PETER SANDSTONE MONITORING WELL

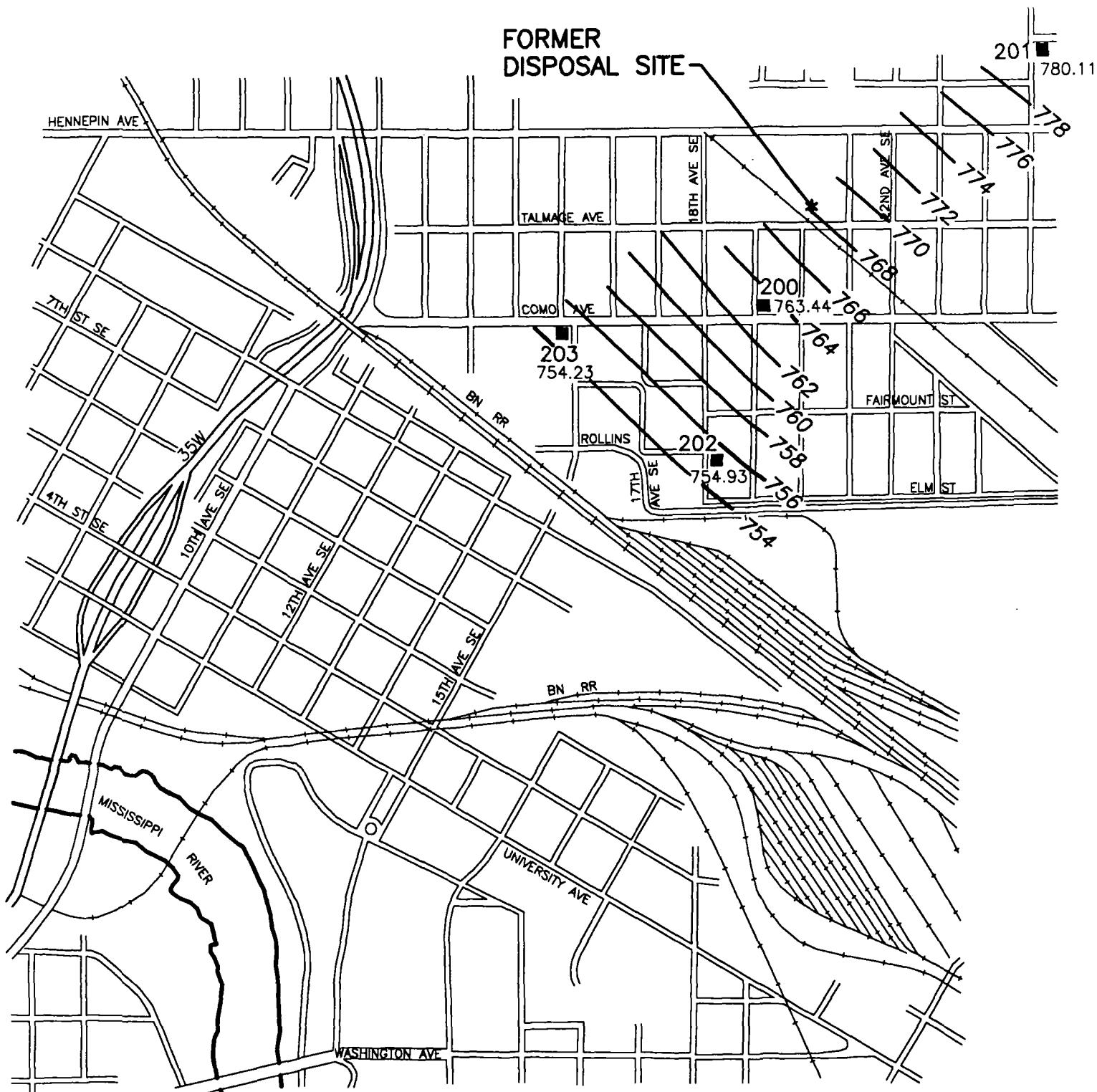
754.0 ST. PETER SANDSTONE POTENTIOMETRIC SURFACE ELEVATION (MSL)

— ST. PETER SANDSTONE POTENTIOMETRIC SURFACE CONTOUR (MSL)



0 1000
SCALE IN FEET

Figure 15
ST. PETER SANDSTONE
POTENTIOMETRIC SURFACE ELEVATION
MAY 1992



■ ST. PETER SANDSTONE MONITORING WELL

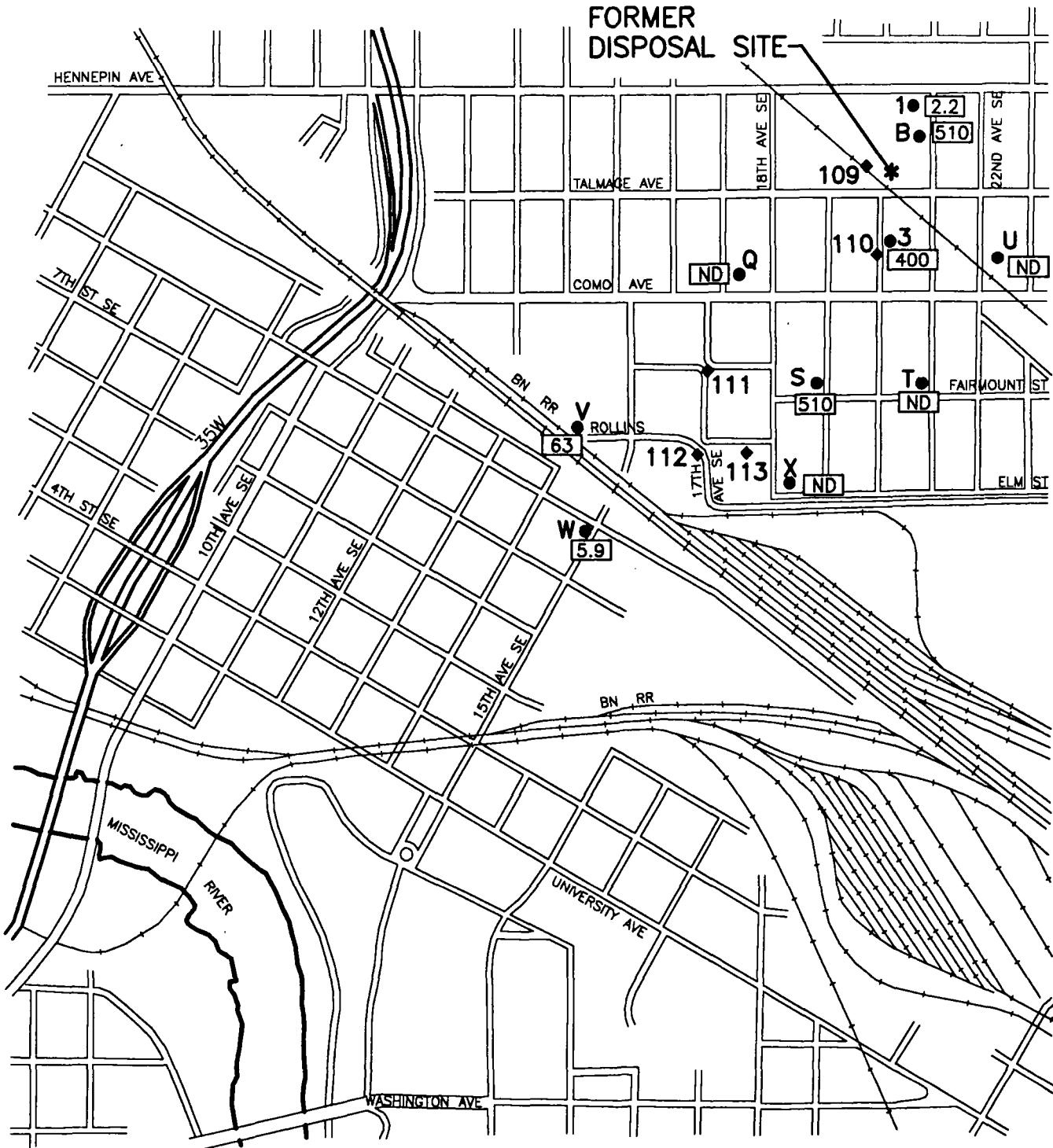
756.0 ST. PETER SANDSTONE POTENTIOMETRIC SURFACE ELEVATION (MSL)

— ST. PETER SANDSTONE POTENTIOMETRIC SURFACE CONTOUR (MSL)



0 1000
SCALE IN FEET

Figure 16
ST. PETER SANDSTONE
POTENTIOMETRIC SURFACE ELEVATION
NOVEMBER 1992

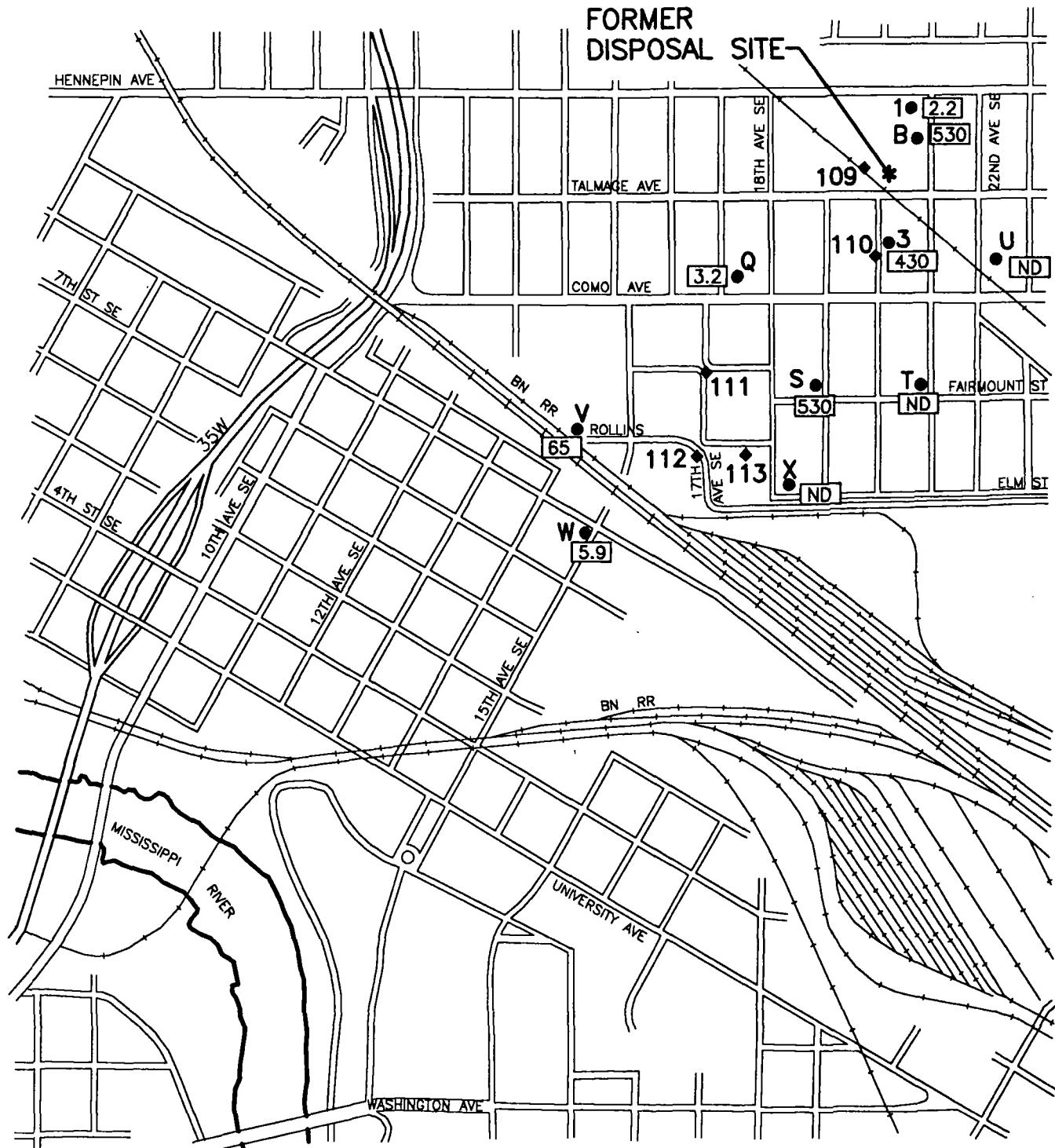


- GLACIAL DRIFT MONITORING WELL
- ◆ SITE AND DOWNGRADIENT GLACIAL DRIFT PUMP-OUT WELL
- 63 TRICHLOROETHENE CONCENTRATION (TCE) ($\mu\text{g/L}$)
- ND NOT DETECTED



0 1000
SCALE IN FEET

Figure 17
GLACIAL DRIFT AQUIFER
WATER QUALITY (TCE)
MAY 1992

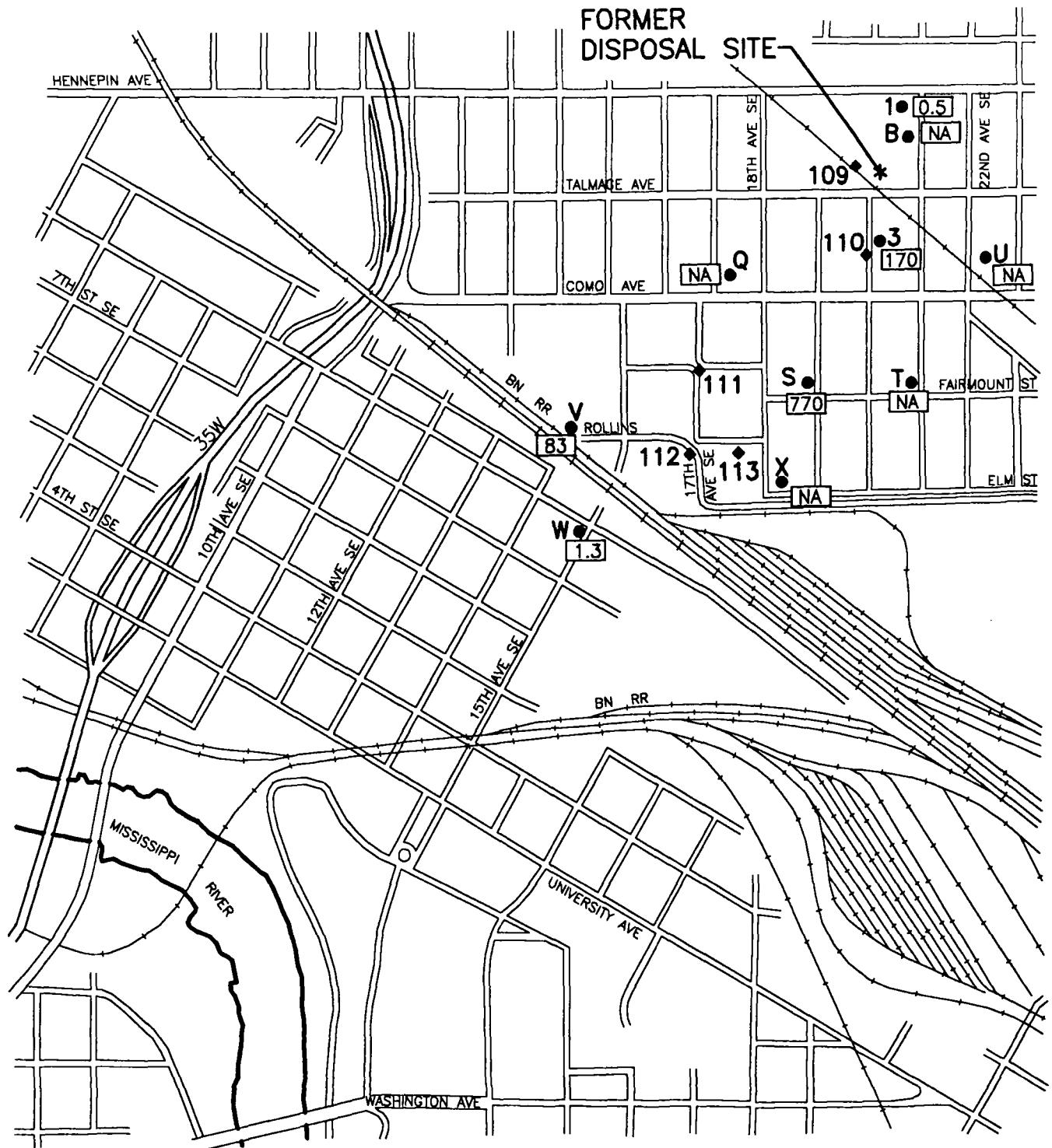


- GLACIAL DRIFT MONITORING WELL
- ◆ SITE AND DOWNGRADIENT GLACIAL DRIFT PUMP-OUT WELL
- [65] TRICHLOROETHENE CONCENTRATION (TCE) ($\mu\text{g}/\text{L}$)
- [ND] NOT DETECTED



0 1000
SCALE IN FEET

Figure 18
GLACIAL DRIFT AQUIFER
WATER QUALITY (VOC)
MAY 1992



- GLACIAL DRIFT MONITORING WELL
- ◆ SITE AND DOWNGRADIENT GLACIAL DRIFT PUMP-OUT WELL
- 83** TRICHLOROETHENE CONCENTRATION (TCE) ($\mu\text{g/L}$)
- ND** NOT DETECTED
- NA** NOT ANALYZED

0 1000
SCALE IN FEET

Figure 19

GLACIAL DRIFT AQUIFER
WATER QUALITY (TCE)
NOVEMBER 1992

Trichloroethene vs. Time

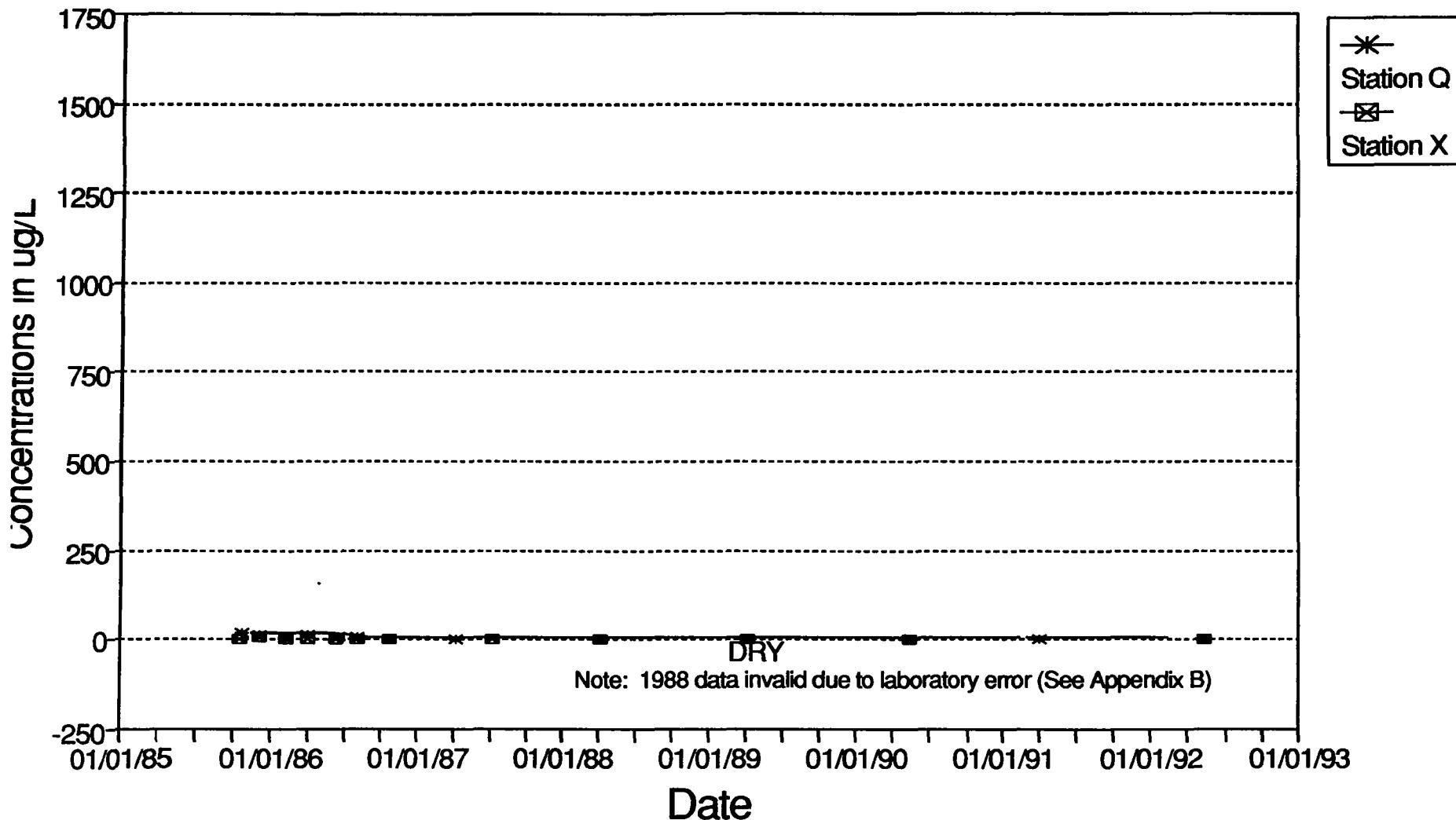


FIGURE 20
GLACIAL DRIFT WELLS
TCE CONCENTRATIONS
1985-1992

Trichloroethene vs. Time

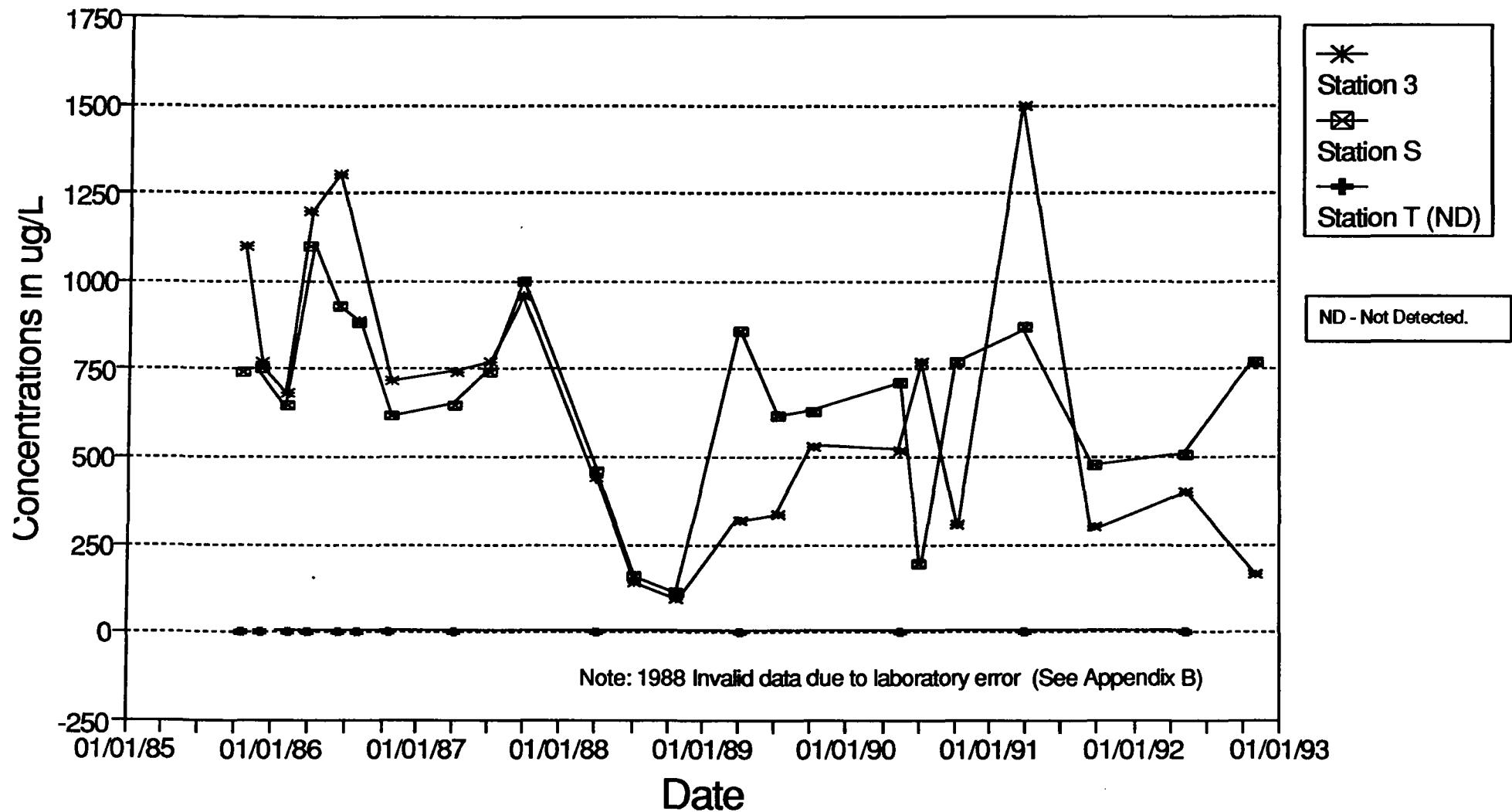


FIGURE 20 (cont.)
GLACIAL DRIFT WELLS
TCE CONCENTRATIONS
1985-1992

Trichloroethene vs. Time

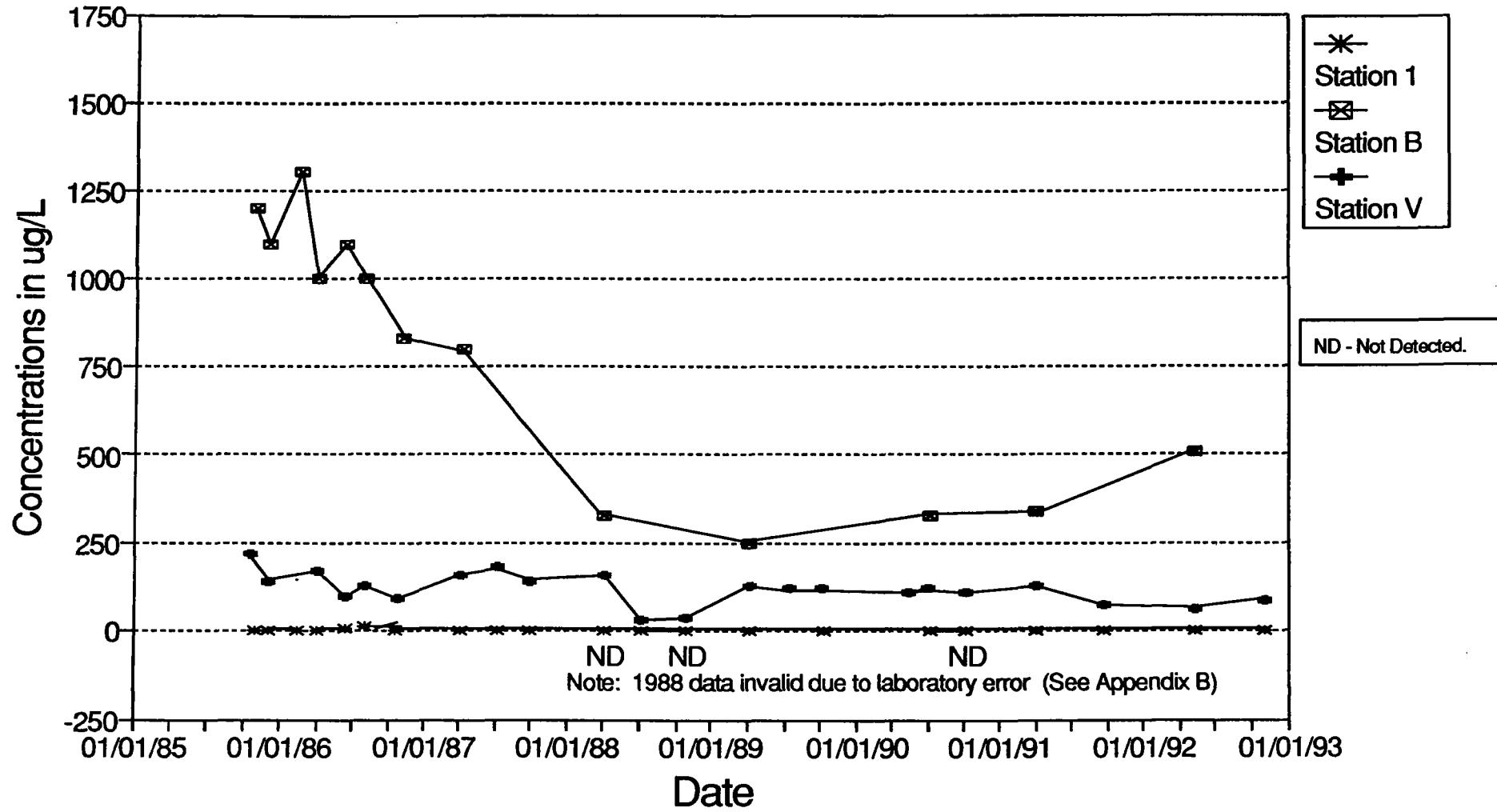


FIGURE 20 (cont.)
GLACIAL DRIFT WELLS
TCE CONCENTRATIONS
1985-1992

Trichloroethene vs. Time

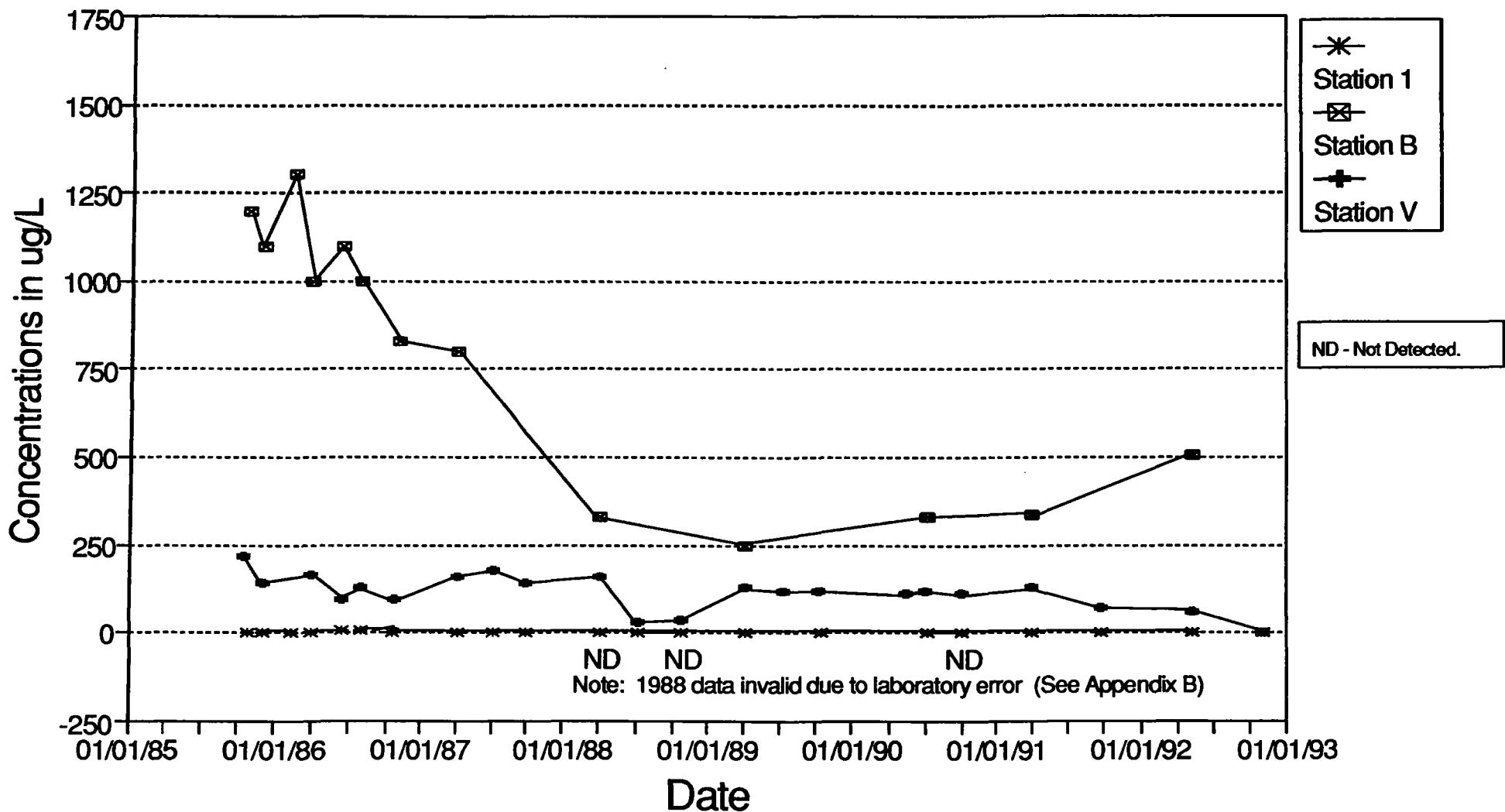


FIGURE 20 (cont.)
GLACIAL DRIFT WELLS
TCE CONCENTRATIONS
1985-1992

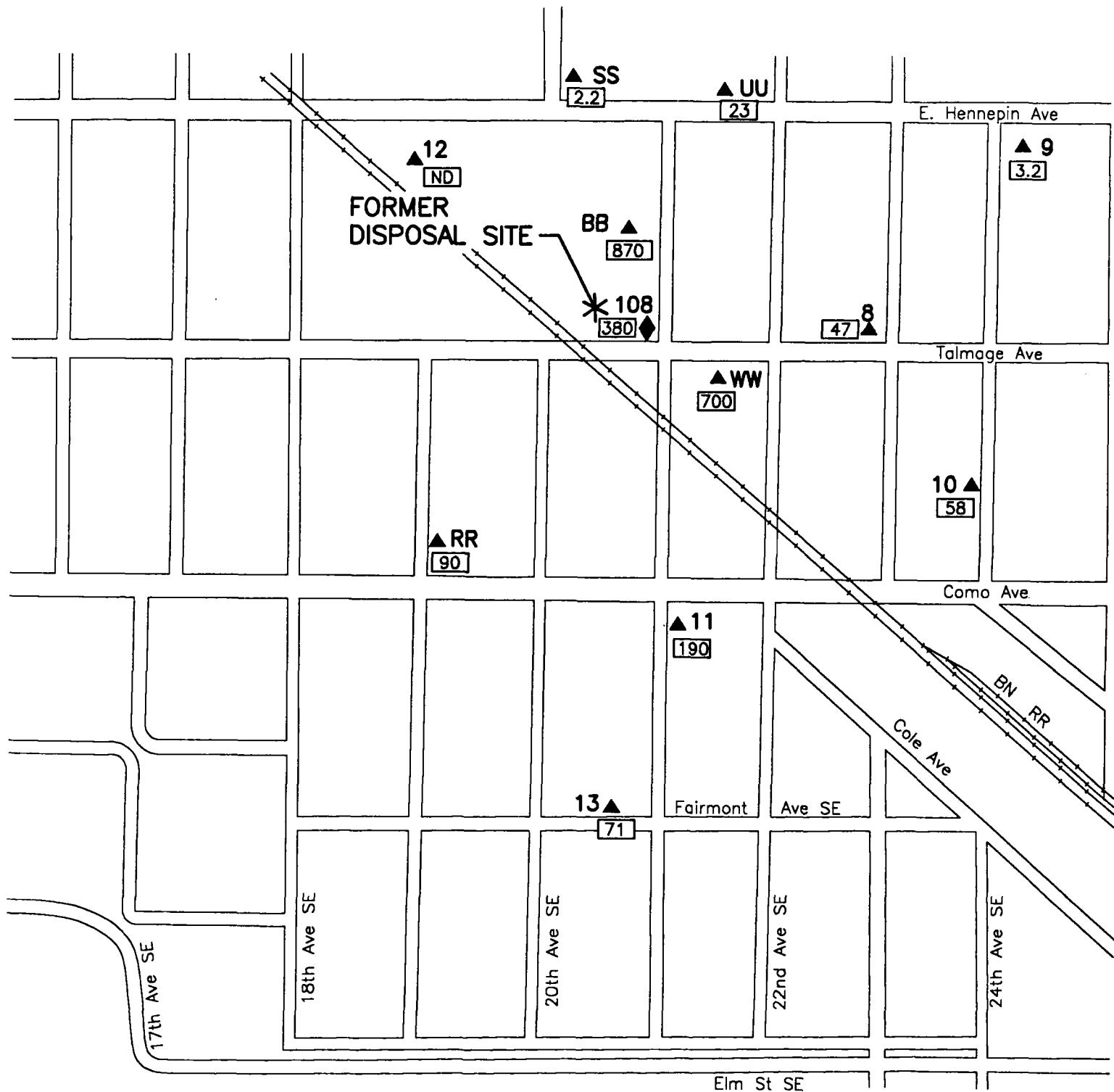
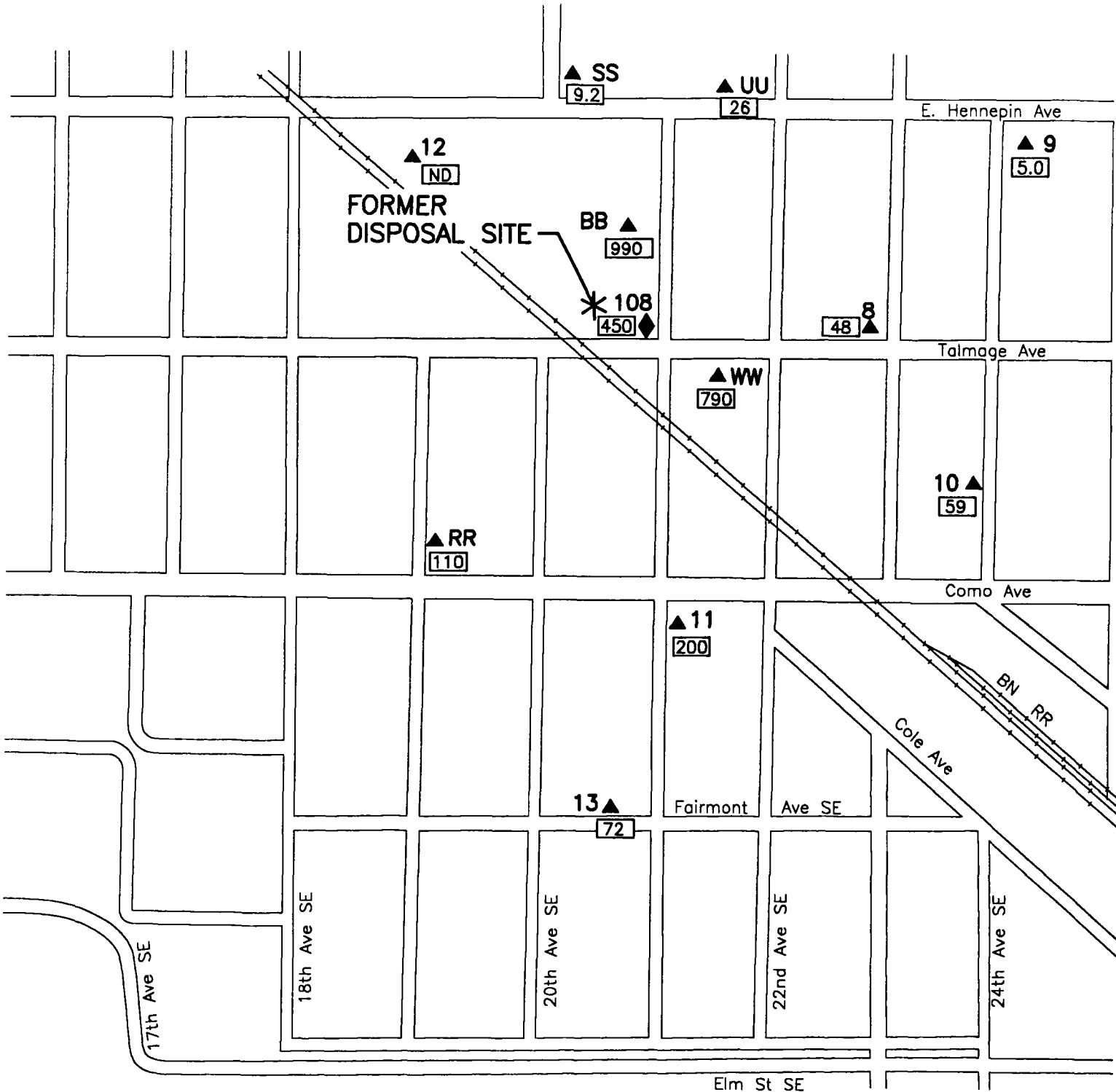


Figure 21
CARIMONA MEMBER
WATER QUALITY (TCE)
MAY 1992



▲ CARIMONA MEMBER MONITORING WELL

◆ CARIMONA MEMBER PUMP-OUT WELL

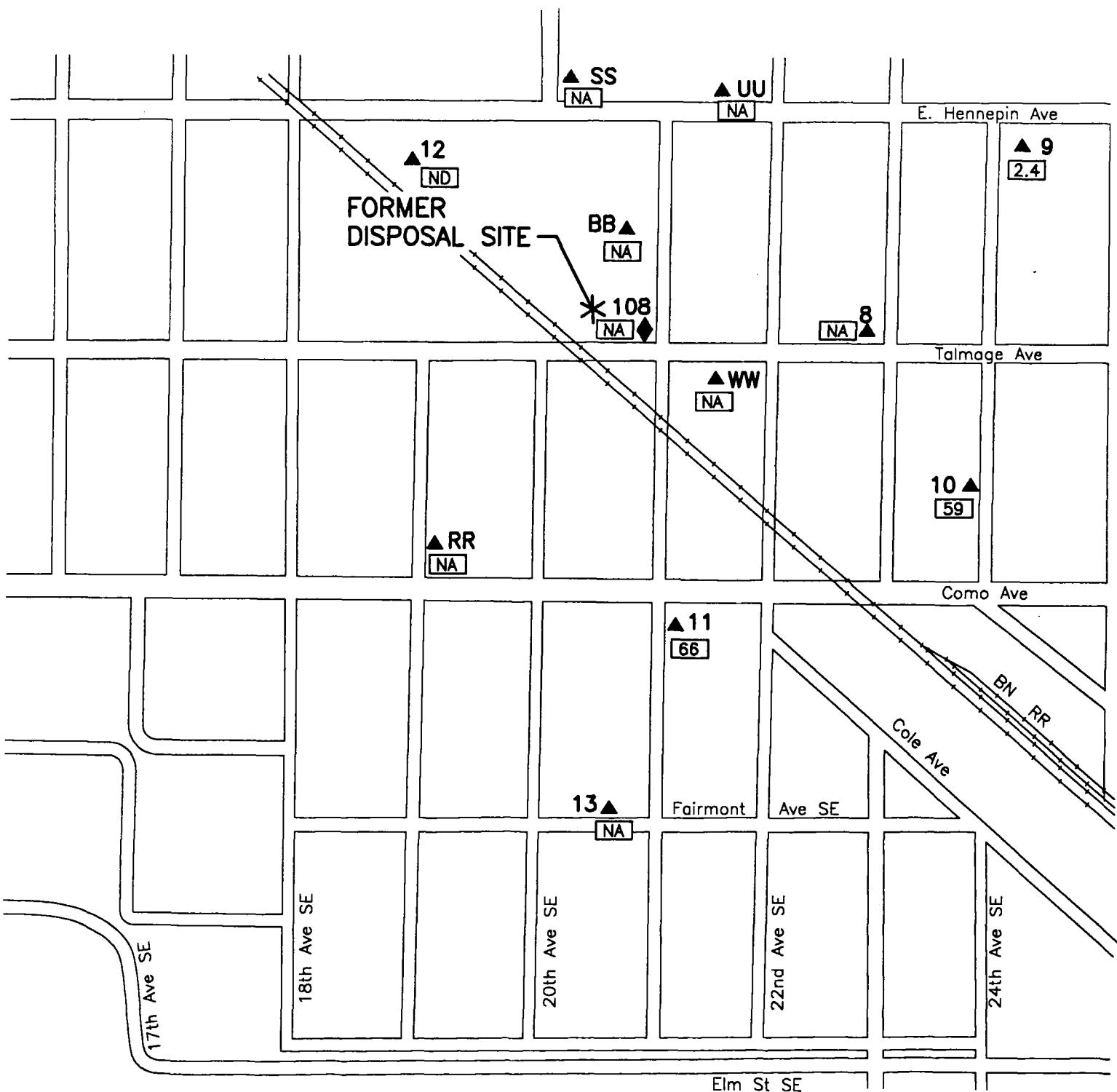
[200] SUM OF VOLATILE ORGANIC CONCENTRATIONS (VOC) (ug/L)

[ND] NOT DETECTED



0 200 400
SCALE IN FEET

Figure 22
CARIMONA MEMBER
WATER QUALITY (VOC)
MAY 1992



- ▲ CARIMONA MEMBER MONITORING WELL
- ◆ CARIMONA MEMBER PUMP-OUT WELL
- 66 TRICHLOROETHENE CONCENTRATION (TCE) (ug/L)
- ND NOT DETECTED
- NA NOT ANALYZED

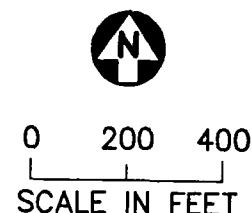


Figure 23
CARIMONA MEMBER
WATER QUALITY (TCE)
NOVEMBER 1992

Trichloroethene vs. Time

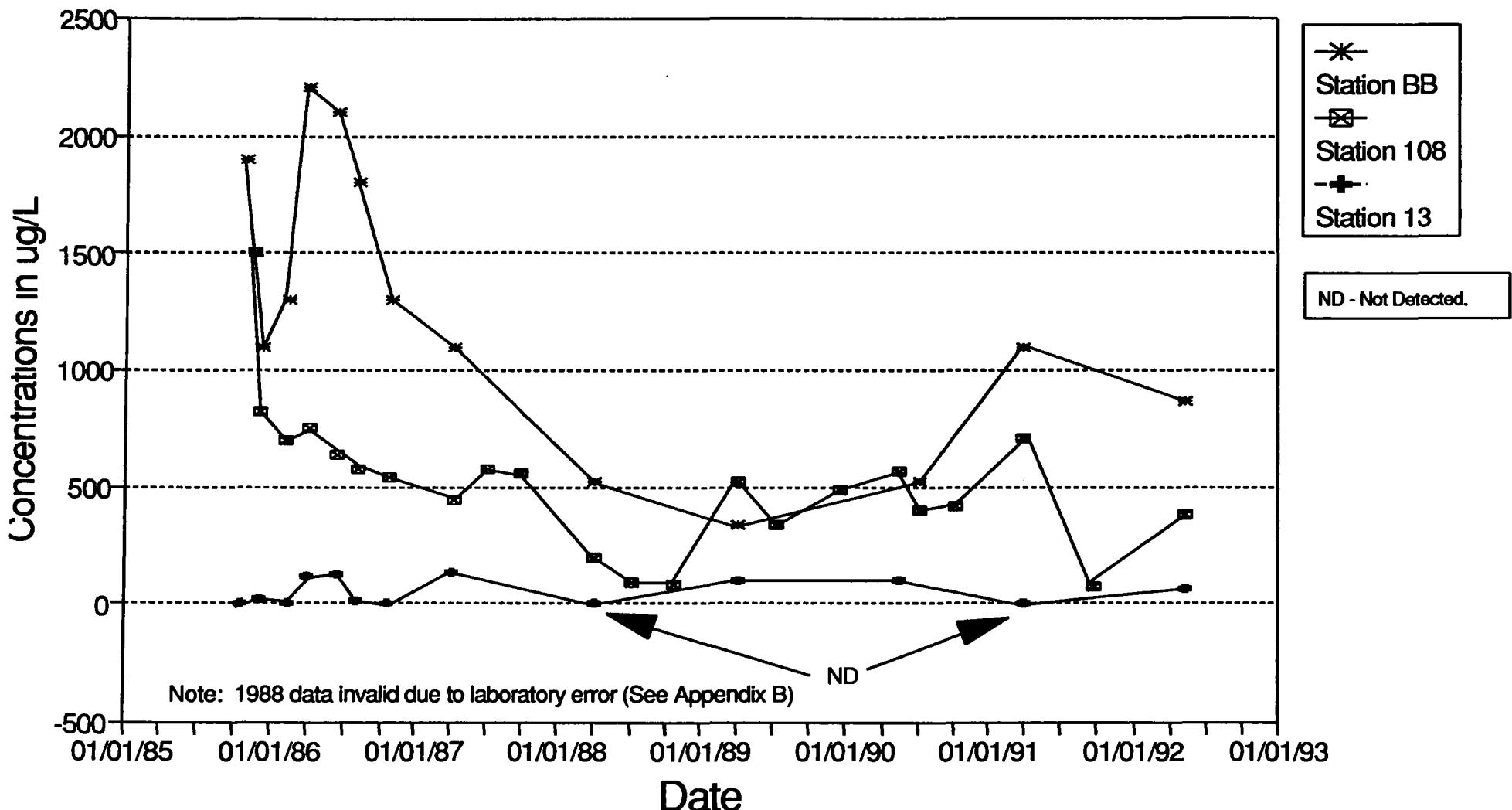


FIGURE 24
CARIMONA MEMBER WELLS
TCE CONCENTRATIONS
1985-1992

Trichloroethene vs. Time

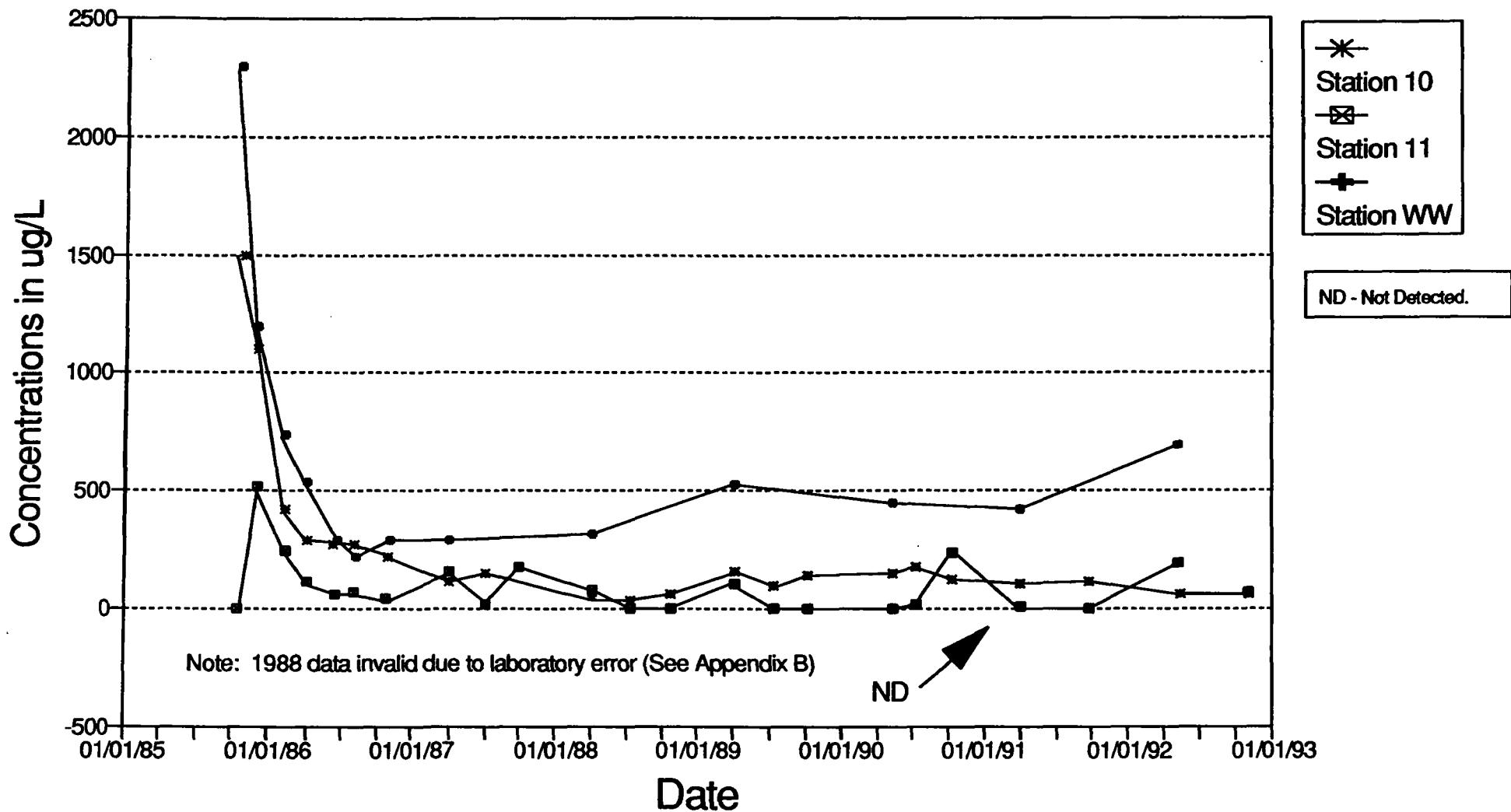
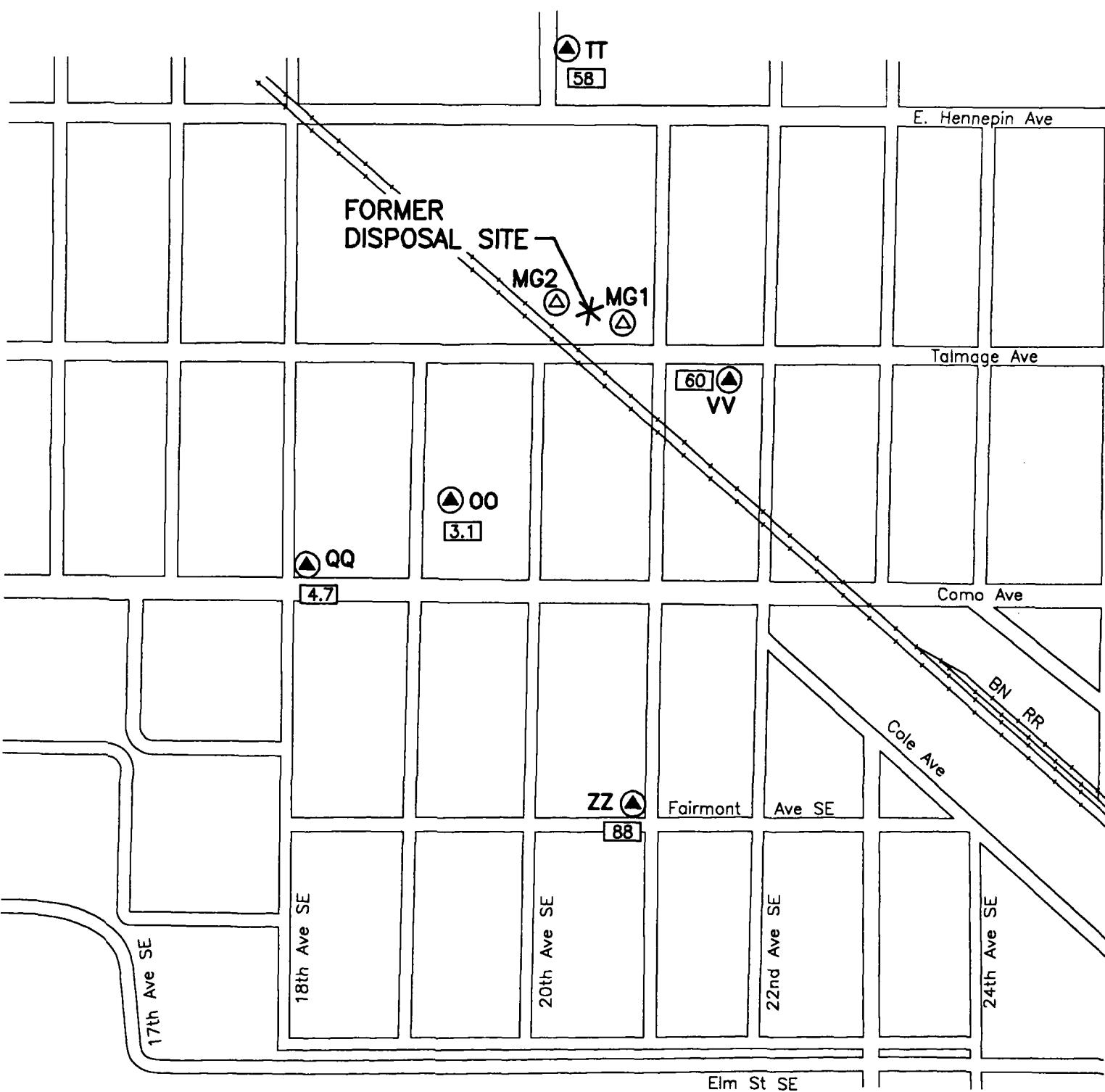


FIGURE 24 (cont.)
CARIMONA MEMBER WELLS
TCE CONCENTRATIONS
1985-1992



- (▲) MAGNOLIA MEMBER MONITORING WELL
- (△) MAGNOLIA MEMBER PUMP-OUT WELL
- (88) TRICHLOROETHENE CONCENTRATION (TCE) (ug/L)
- (ND) NOT DETECTED

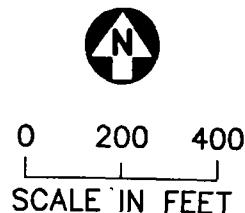
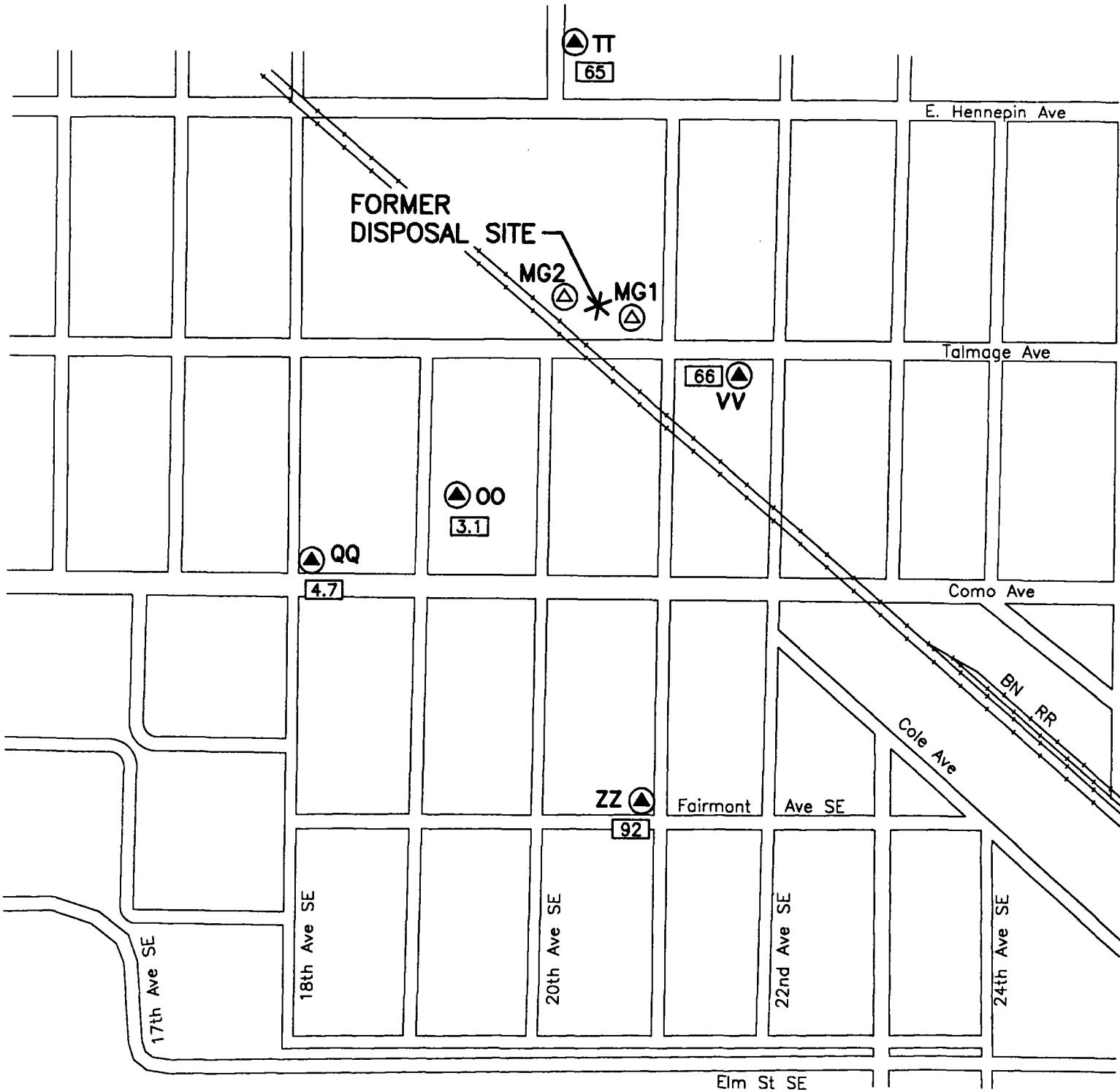


Figure 25
MAGNOLIA MEMBER
WATER QUALITY (TCE)
MAY 1992



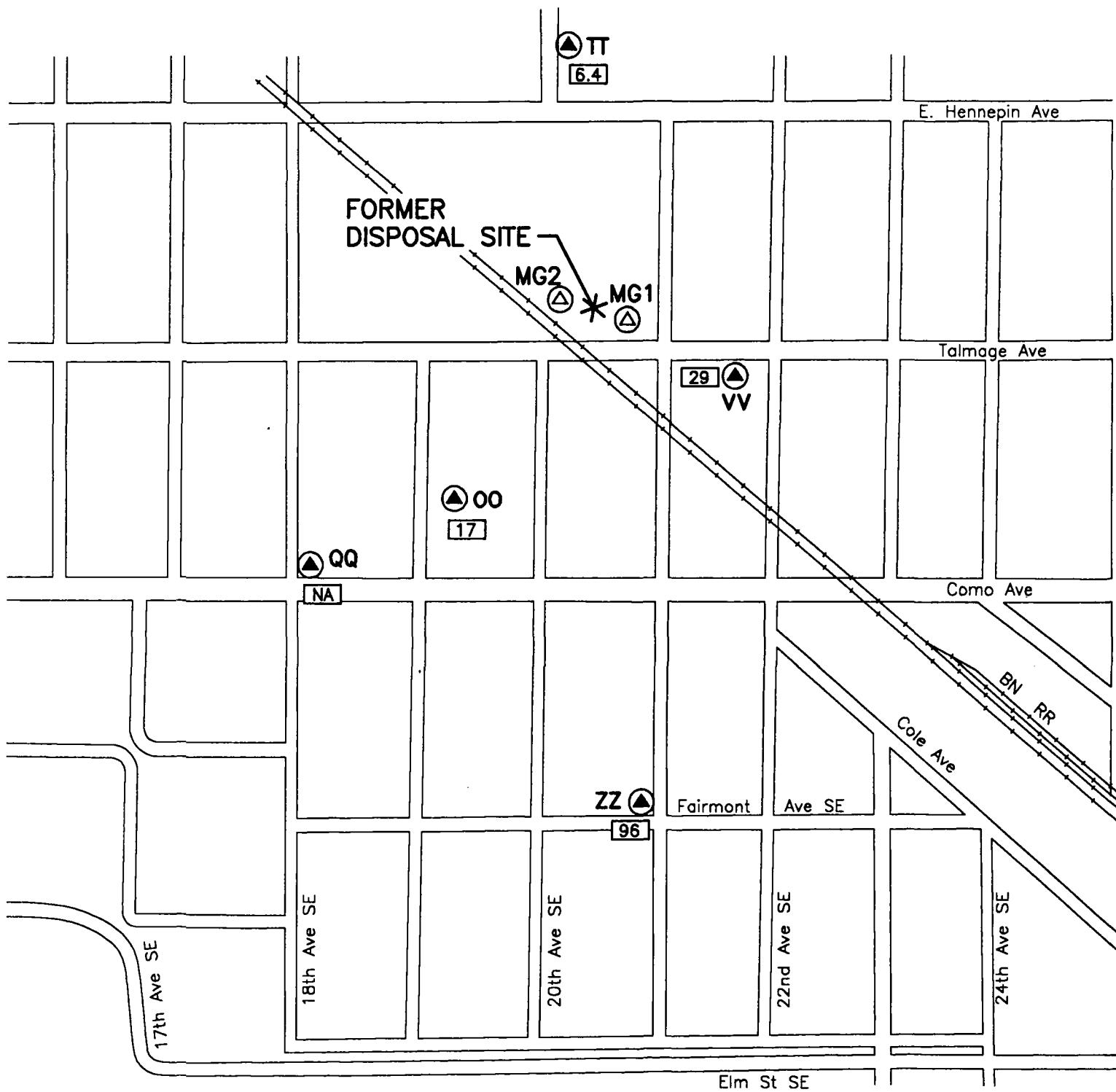
(▲) MAGNOLIA MEMBER MONITORING WELL

(△) MAGNOLIA MEMBER PUMP-OUT WELL

[72] SUM OF VOLATILE ORGANIC CONCENTRATIONS (VOC) (ug/L)

N
0 200 400
SCALE IN FEET

Figure 26
MAGNOLIA MEMBER
WATER QUALITY (VOC)
MAY 1992



- ▲ MAGNOLIA MEMBER MONITORING WELL
- △ MAGNOLIA MEMBER PUMP-OUT WELL
- 96 TRICHLOROETHENE CONCENTRATION (ug/L) (TCE)
- NA NOT ANALYZED

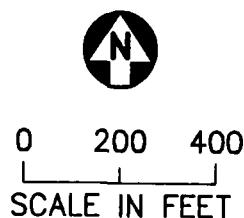


Figure 27
MAGNOLIA MEMBER
WATER QUALITY (TCE)
NOVEMBER 1992

Trichloroethene vs. Time

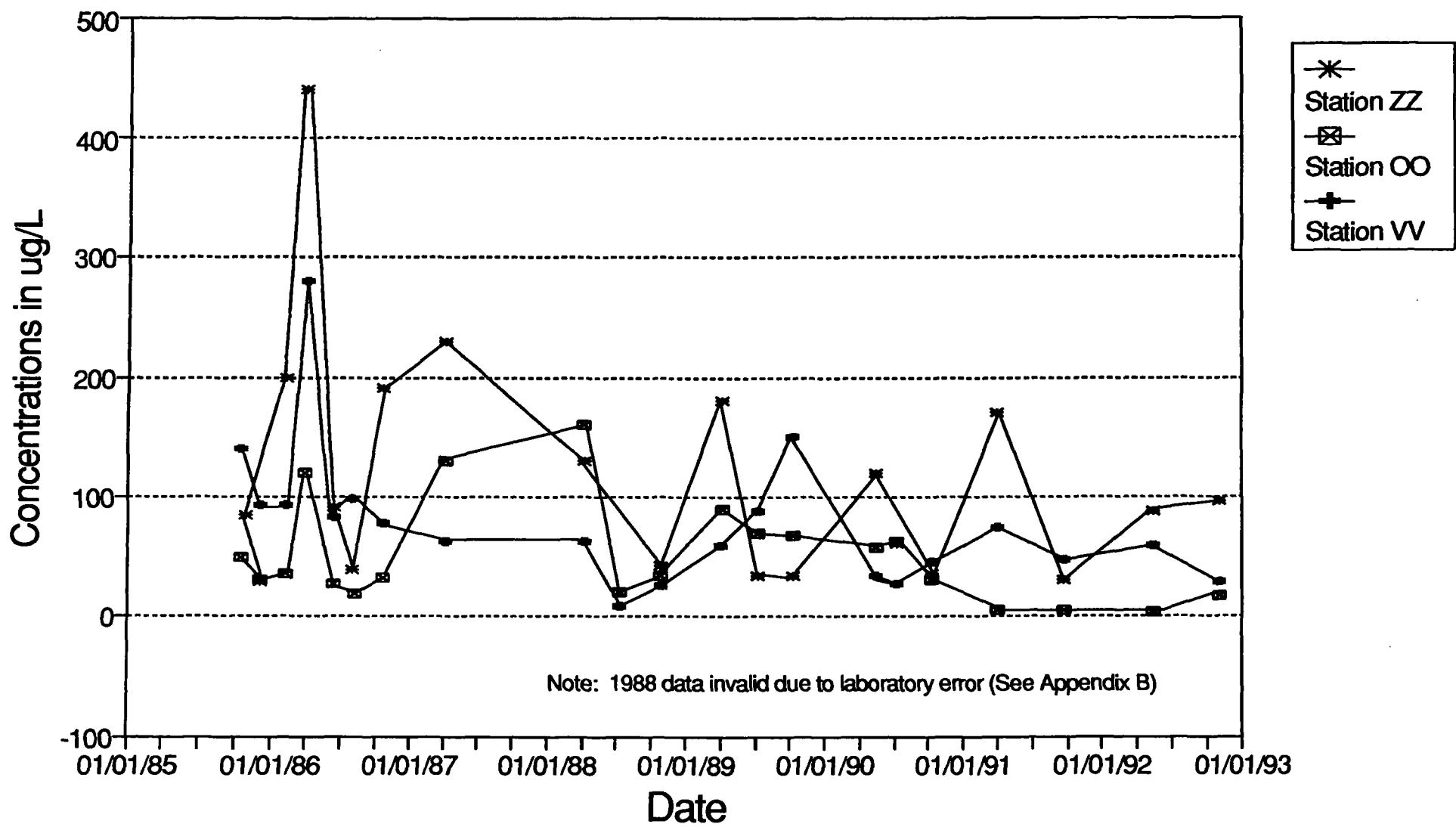


FIGURE 28
MAGNOLIA MEMBER WELLS
TCE CONCENTRATIONS
1985-1992

Trichloroethene vs. Time

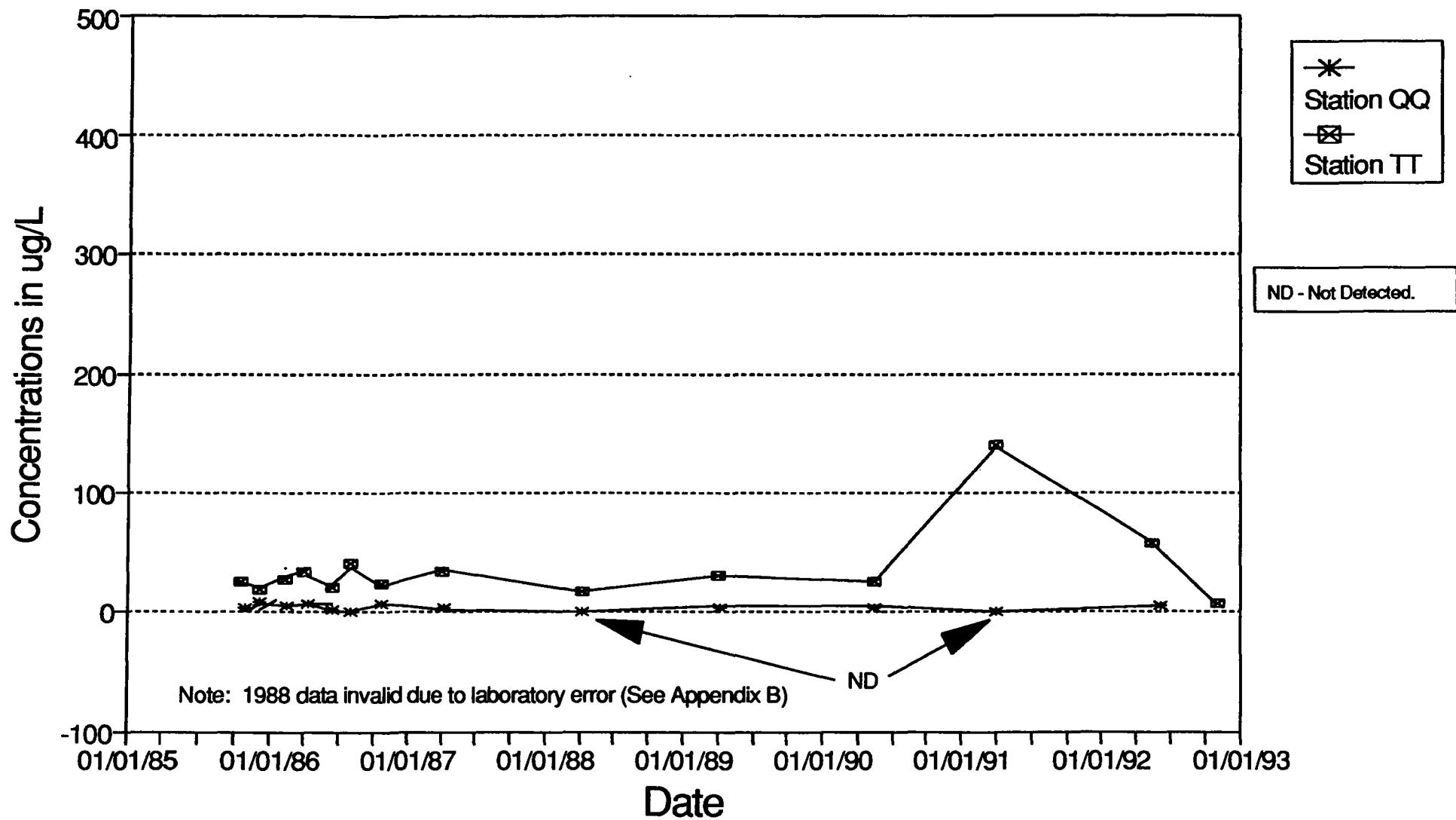
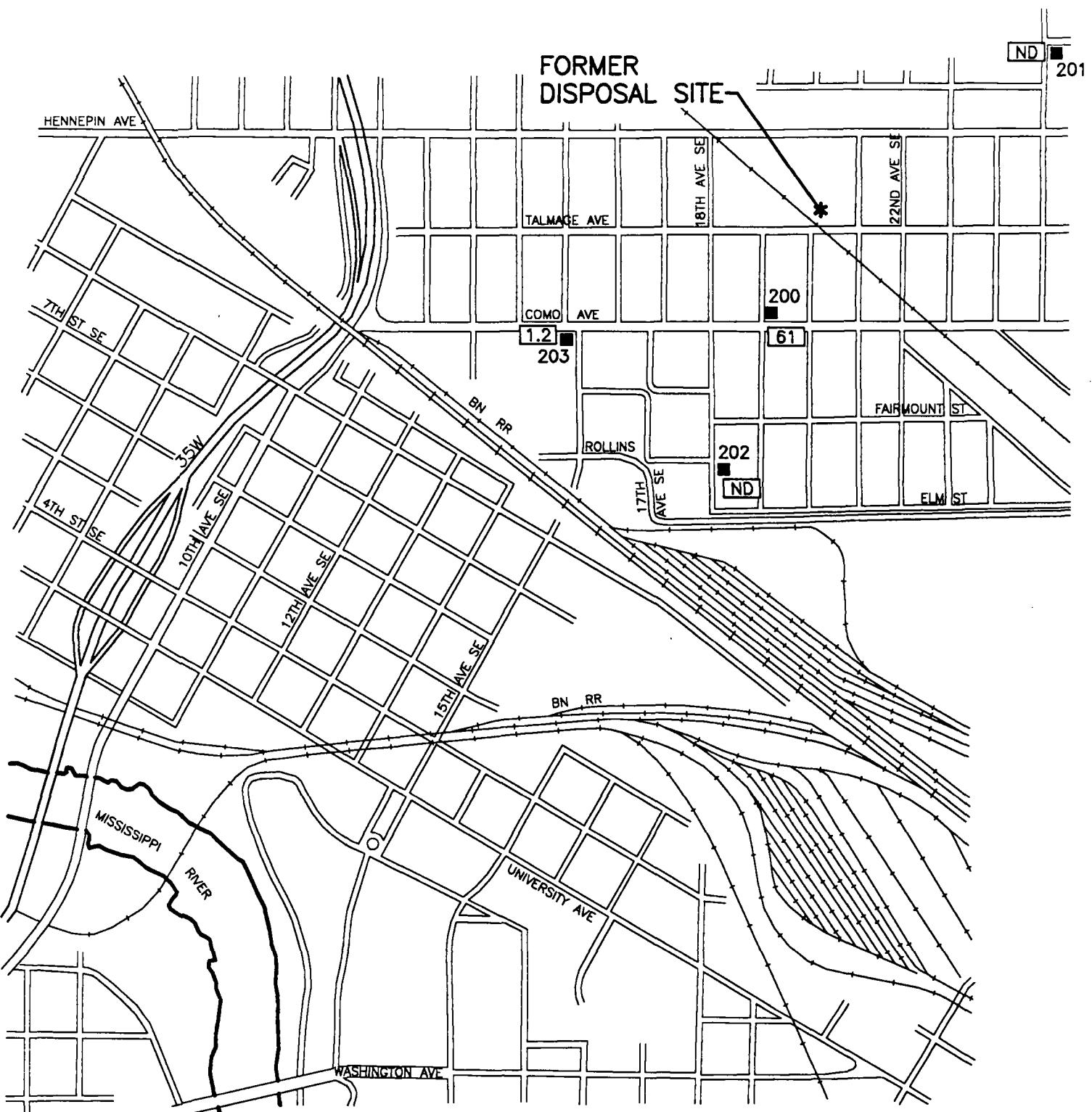


FIGURE 28 (cont.)
MAGNOLIA MEMBER WELLS
TCE CONCENTRATIONS
1985-1992

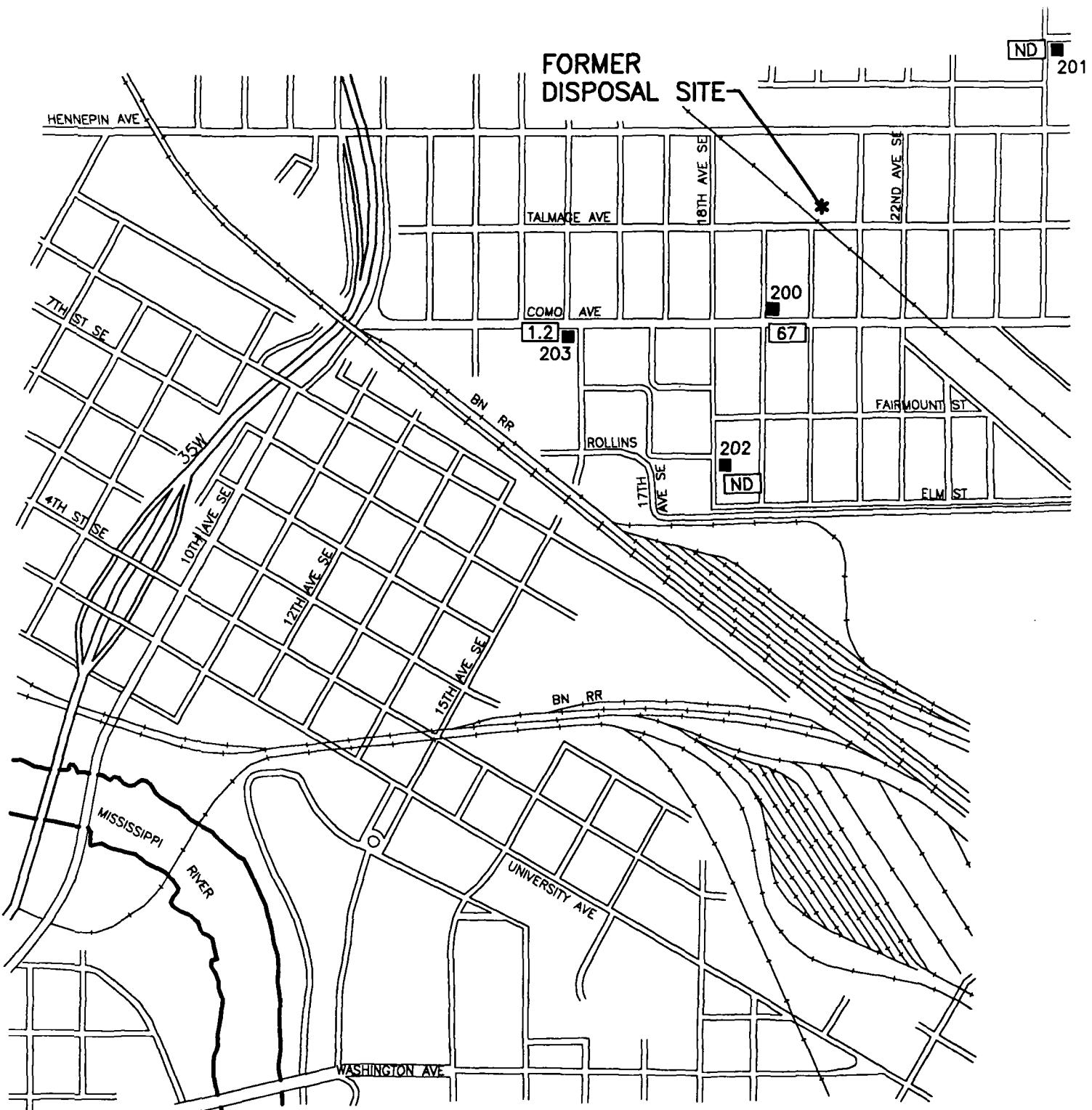


- ST. PETER SANDSTONE MONITORING WELL
- 61 TRICHLOROETHENE CONCENTRATION (TCE) ($\mu\text{g/L}$)
- ND NOT DETECTED

0 1000
SCALE IN FEET



Figure 29
ST. PETER SANDSTONE
WATER QUALITY (TCE)
MAY 1992



■ ST. PETER SANDSTONE MONITORING WELL

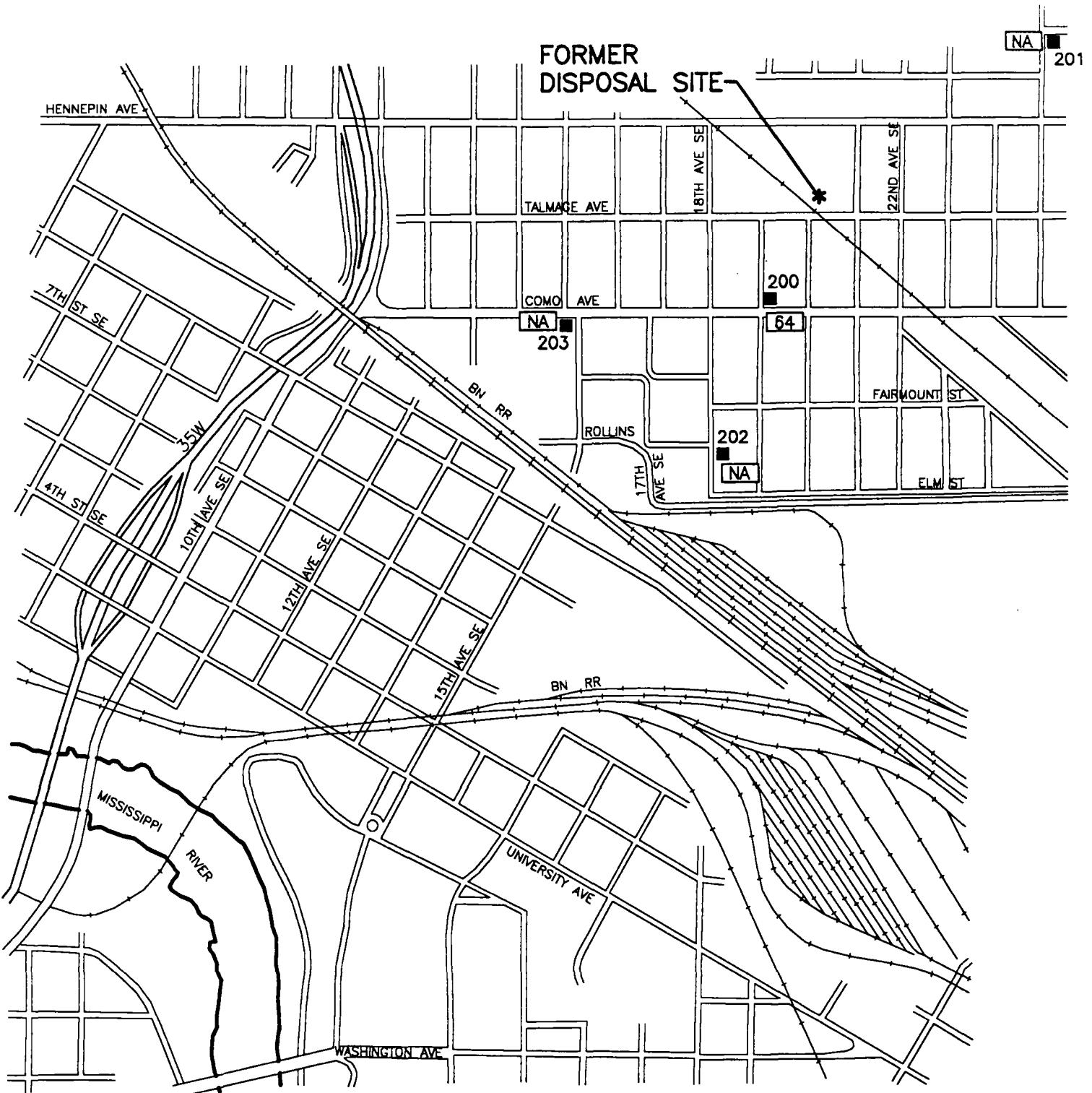
[67] SUM OF VOLATILE ORGANIC CONCENTRATIONS (VOC) (ug/L)

[ND] NOT DETECTED



0 1000
SCALE IN FEET

Figure 30
ST. PETER SANDSTONE
WATER QUALITY (VOC)
MAY 1992



■ ST. PETER SANDSTONE MONITORING WELL

64 TRICHLOROETHENE CONCENTRATION (TCE) (ug/L)

NA NOT ANALYZED



0 1000
SCALE IN FEET

Figure 31
ST. PETER SANDSTONE
WATER QUALITY (TCE)
NOVEMBER 1992

Trichloroethene vs. Time

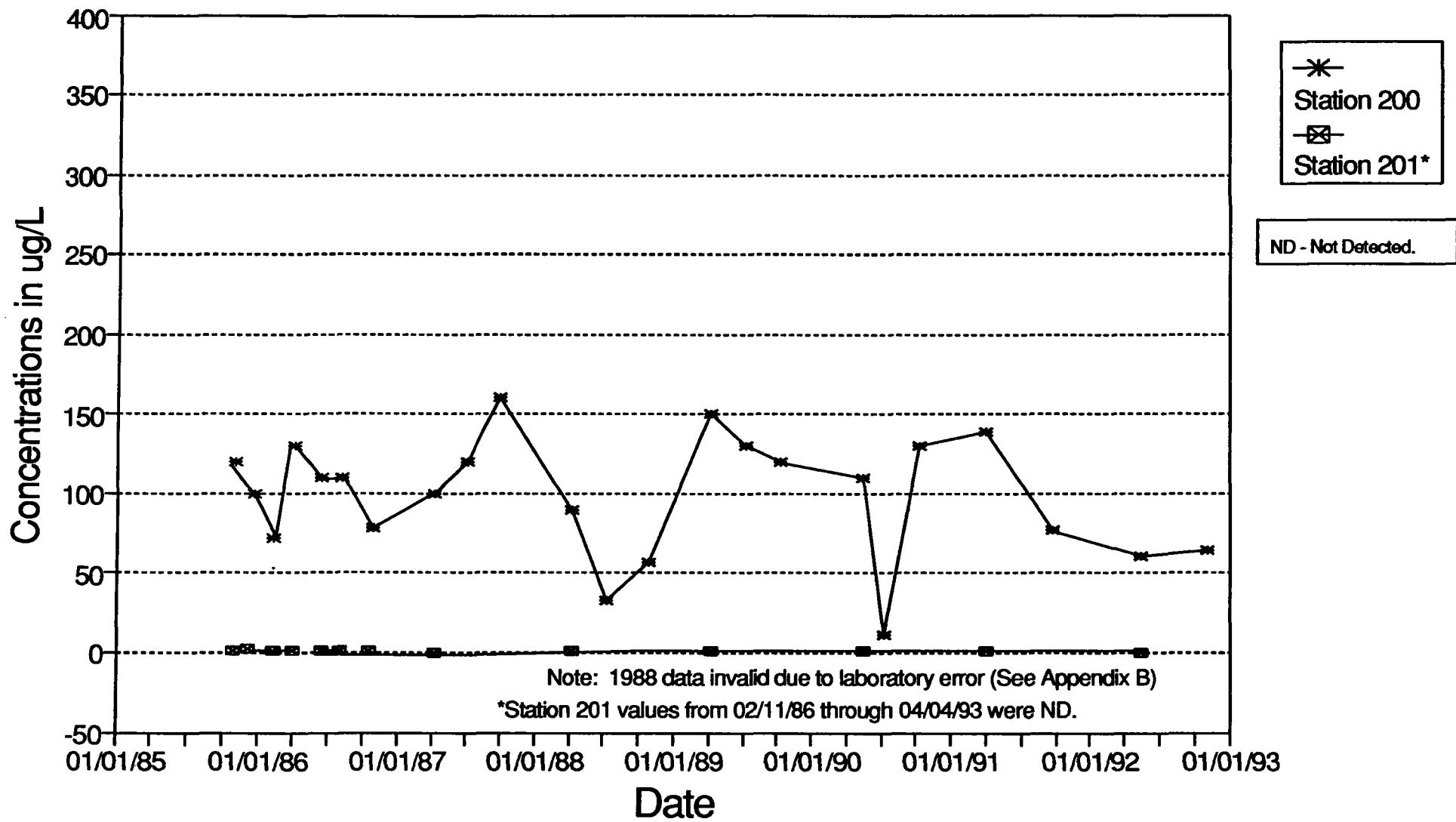


FIGURE 32
ST. PETER SANDSTONE WELLS
TCE CONCENTRATIONS
1985-1992

Trichloroethene vs. Time

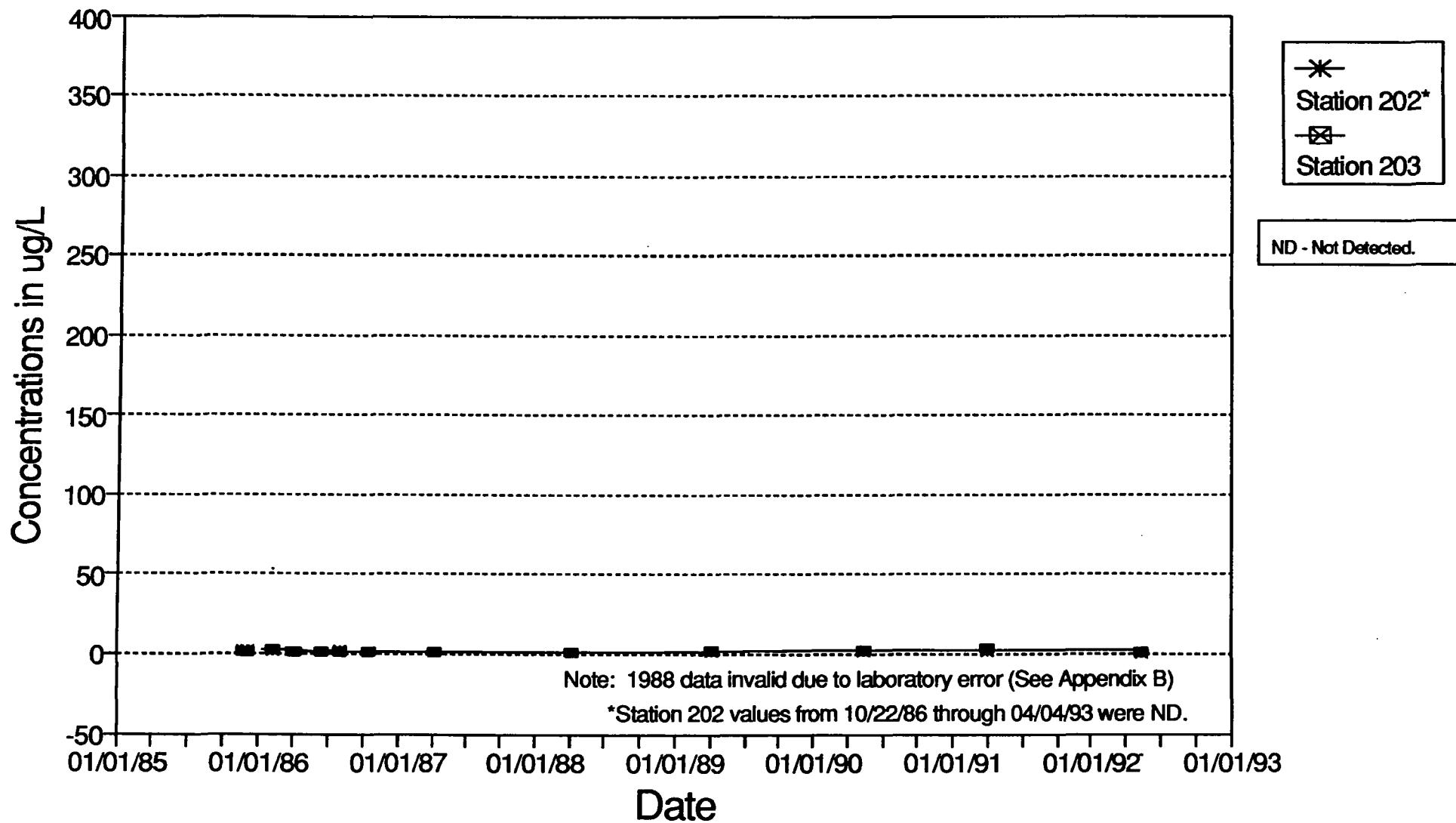


FIGURE 32 (cont.)
ST. PETER SANDSTONE WELLS
TCE CONCENTRATIONS
1985-1992

Trichloroethene vs. Time

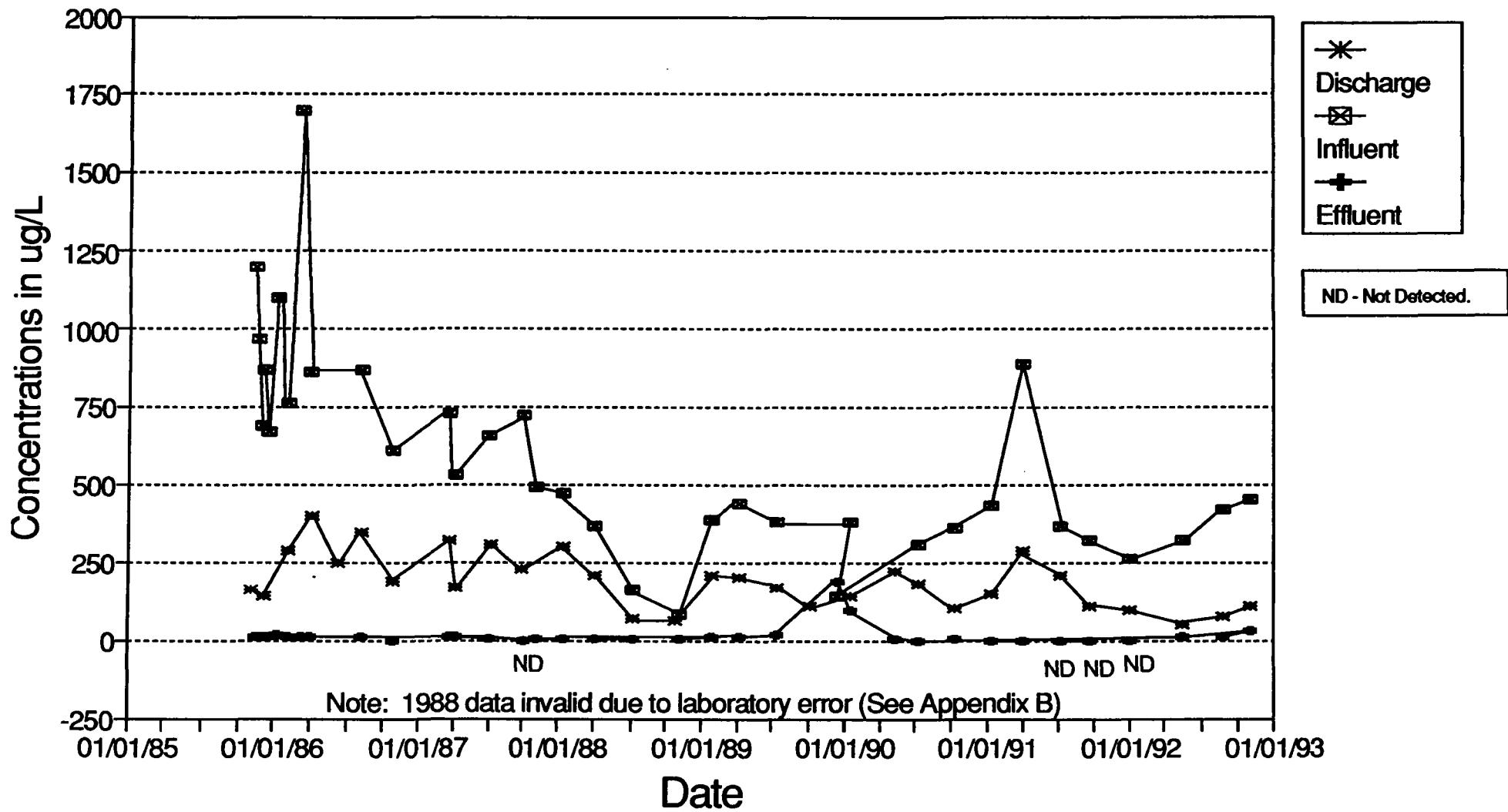


FIGURE 33
DOWNGRADIENT PUMP-OUT SYSTEM DISCHARGE
(111,112,113) AND GOUNDWATER TREATMENT
SYSTEM INFLUENT/EFFLUENT (108,109,110)*
TCE CONCENTRATIONS
1985-1992

* Well 108 removed from system, September 23, 1992

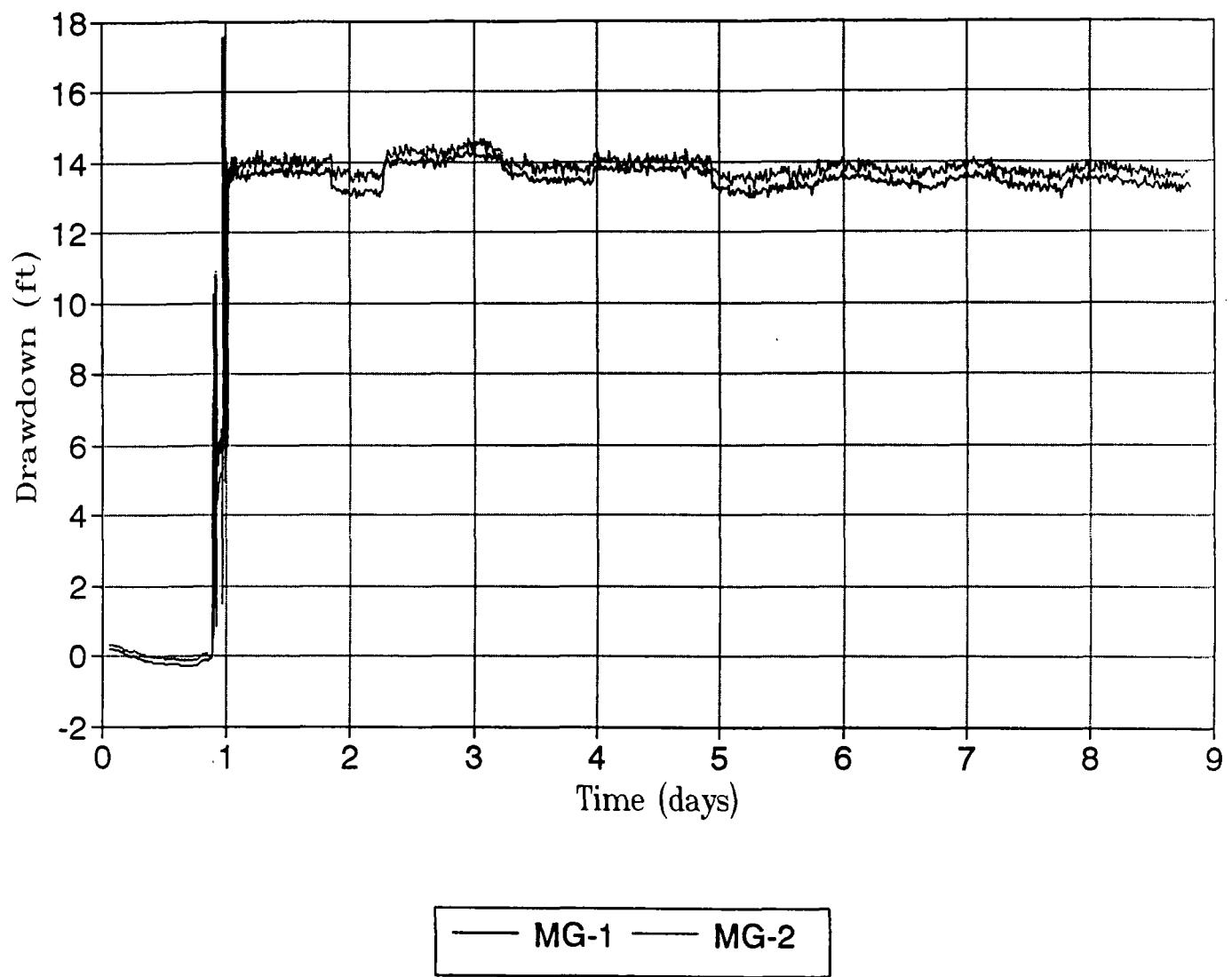
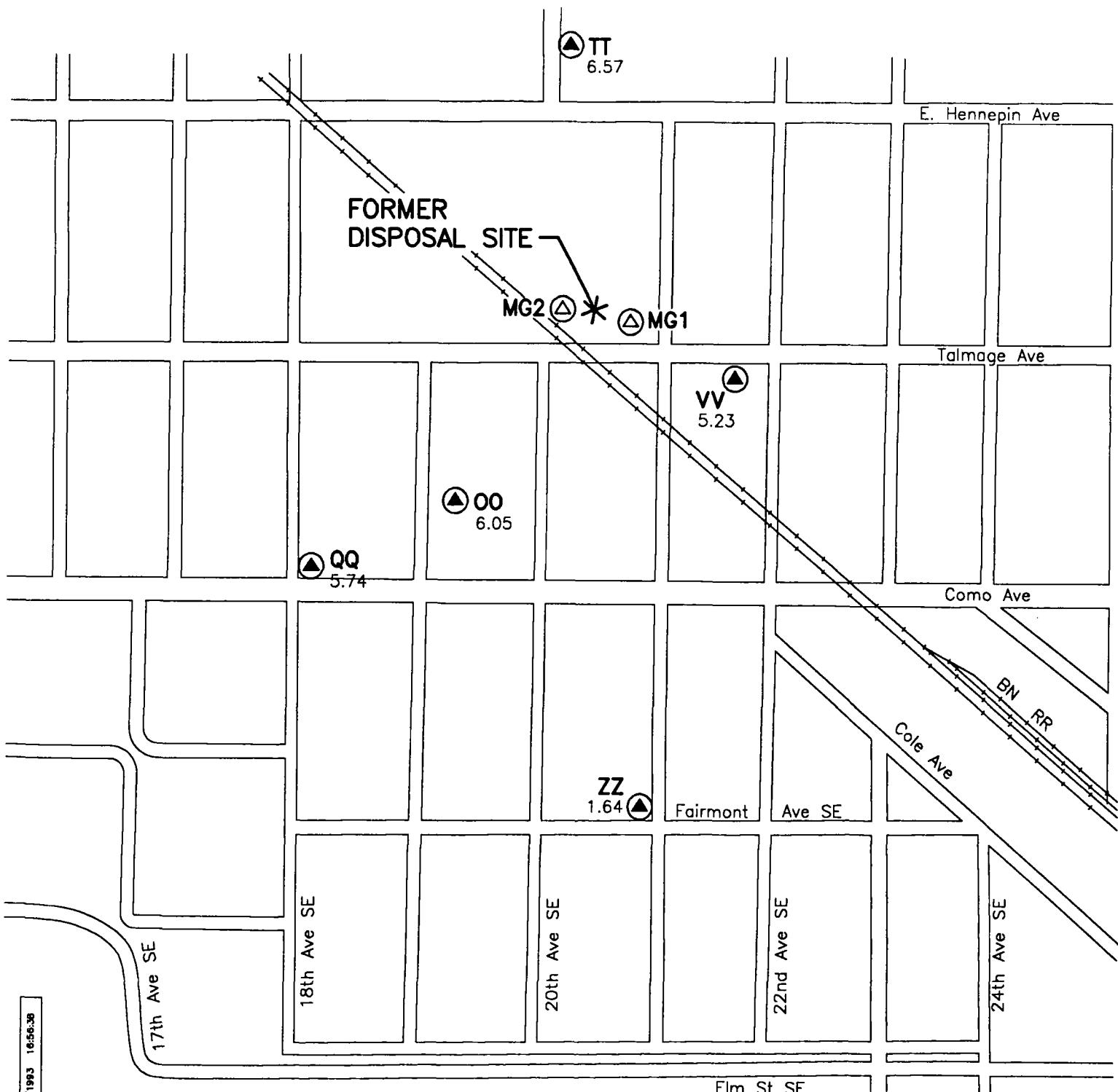


Figure 34
DRAWDOWN IN MAGNOLIA PUMP-OUT WELLS MG1 AND MG2
THROUGHOUT START-UP MONITORING PERIOD



▲ MAGNOLIA MEMBER MONITORING WELL

△ MAGNOLIA MEMBER PUMP-OUT WELL

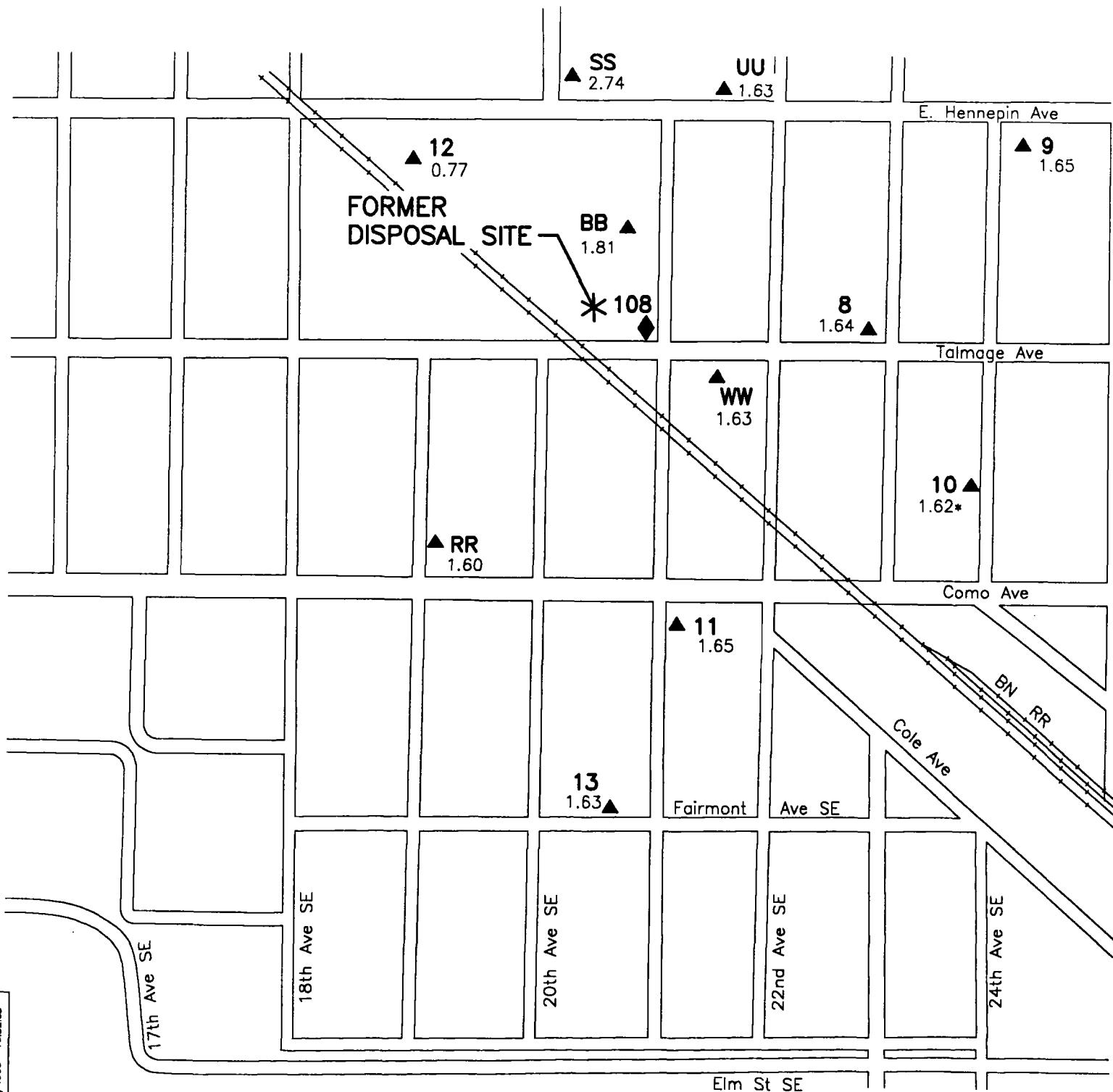
1.64 DRAWDOWN AFTER 8 DAYS OF PUMPING



0 200 400
SCALE IN FEET

Figure 35

DRAWDOWN IN MAGNOLIA MEMBER
WELLS AT END OF START-UP
MONITORING PERIOD
OCTOBER 1, 1992



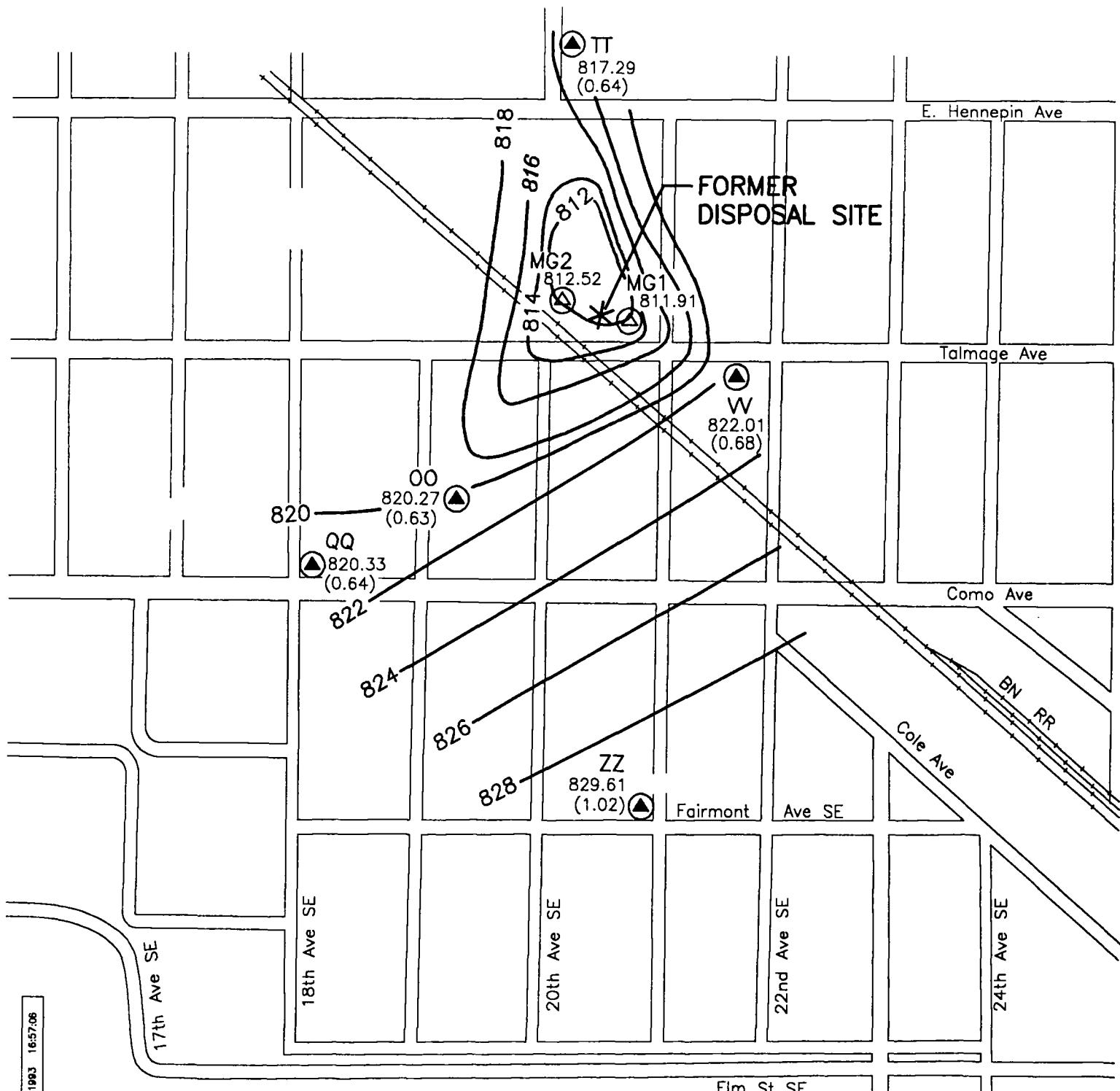
- ▲ CARIMONA MEMBER MONITORING WELL
- ◆ CARIMONA MEMBER PUMP-OUT WELL
- 1.63 WATER LEVEL DIFFERENCE (FT.)
- * READING 10/9/92



0 200 400
SCALE IN FEET

Figure 36

DRAWDOWN IN CARIMONA MEMBER
WELLS AT END OF START-UP
MONITORING PERIOD
OCTOBER 10, 1992



▲ MAGNOLIA MEMBER MONITORING WELL

△ MAGNOLIA MEMBER PUMP-OUT WELL

828.0 MAGNOLIA POTENTIOMETRIC SURFACE ELEVATION (MSL)

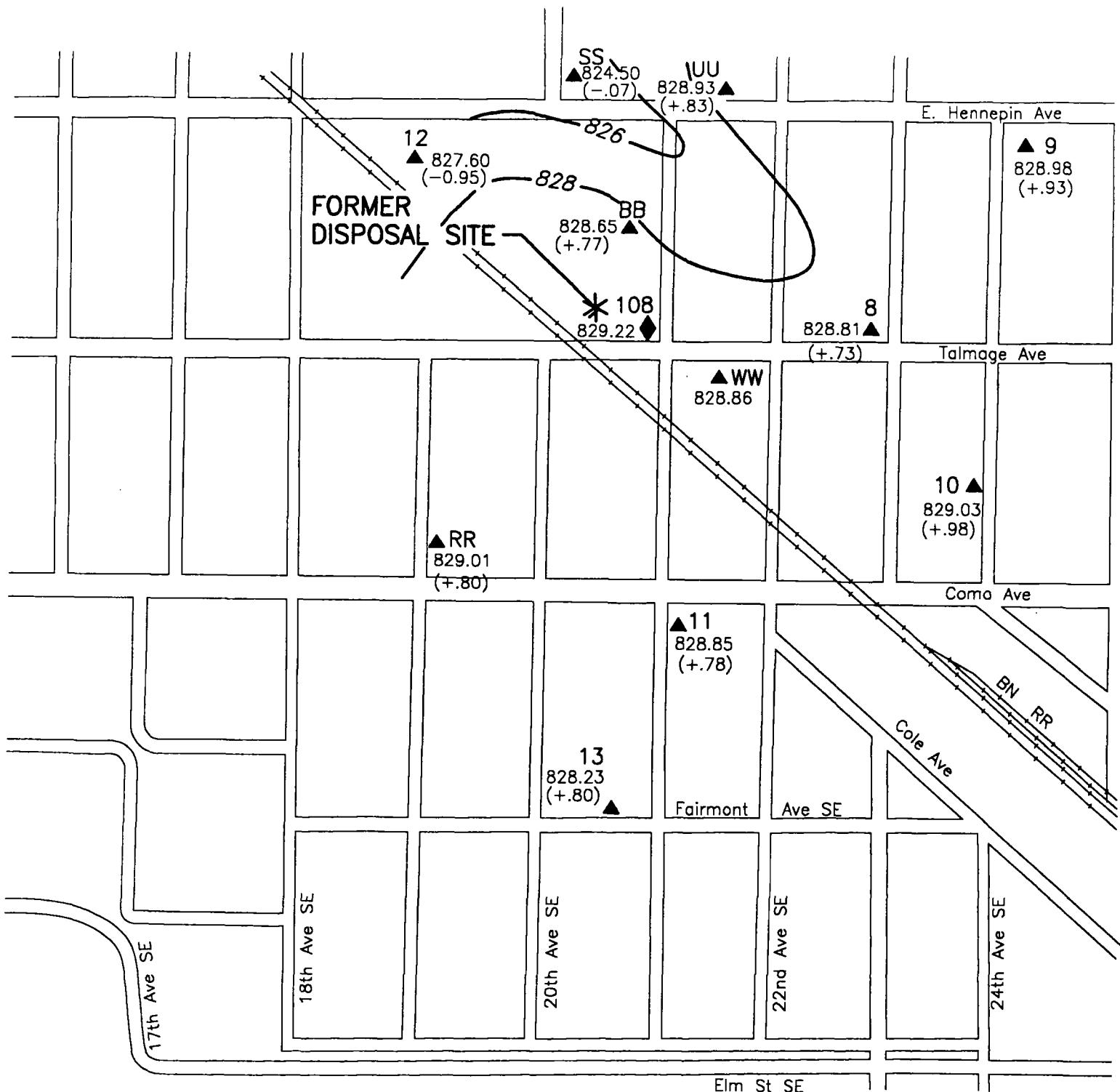
— MAGNOLIA POTENTIOMETRIC SURFACE CONTOUR (MSL)

(0.63) WATER LEVEL CHANGE IN FEET RELATIVE TO END OF
MONITORING PERIOD (10/01/92)



0 200 400
SCALE IN FEET

Figure 37
MAGNOLIA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
NOVEMBER 1992



CARIMONA MEMBER MONITORING WELL



CARIMONA MEMBER PUMP-OUT WELL

828.23

CARIMONA POTENTIOMETRIC SURFACE ELEVATION (MSL)

— 828 —

CARIMONA POTENTIOMETRIC SURFACE CONTOUR (MSL)

(+.73)

WATER LEVEL CHANGE IN FEET RELATIVE TO END OF
MONITORING PERIOD (10/01/92)



0 200 400
SCALE IN FEET

Figure 38
CARIMONA MEMBER
POTENTIOMETRIC SURFACE ELEVATION
NOVEMBER 1992

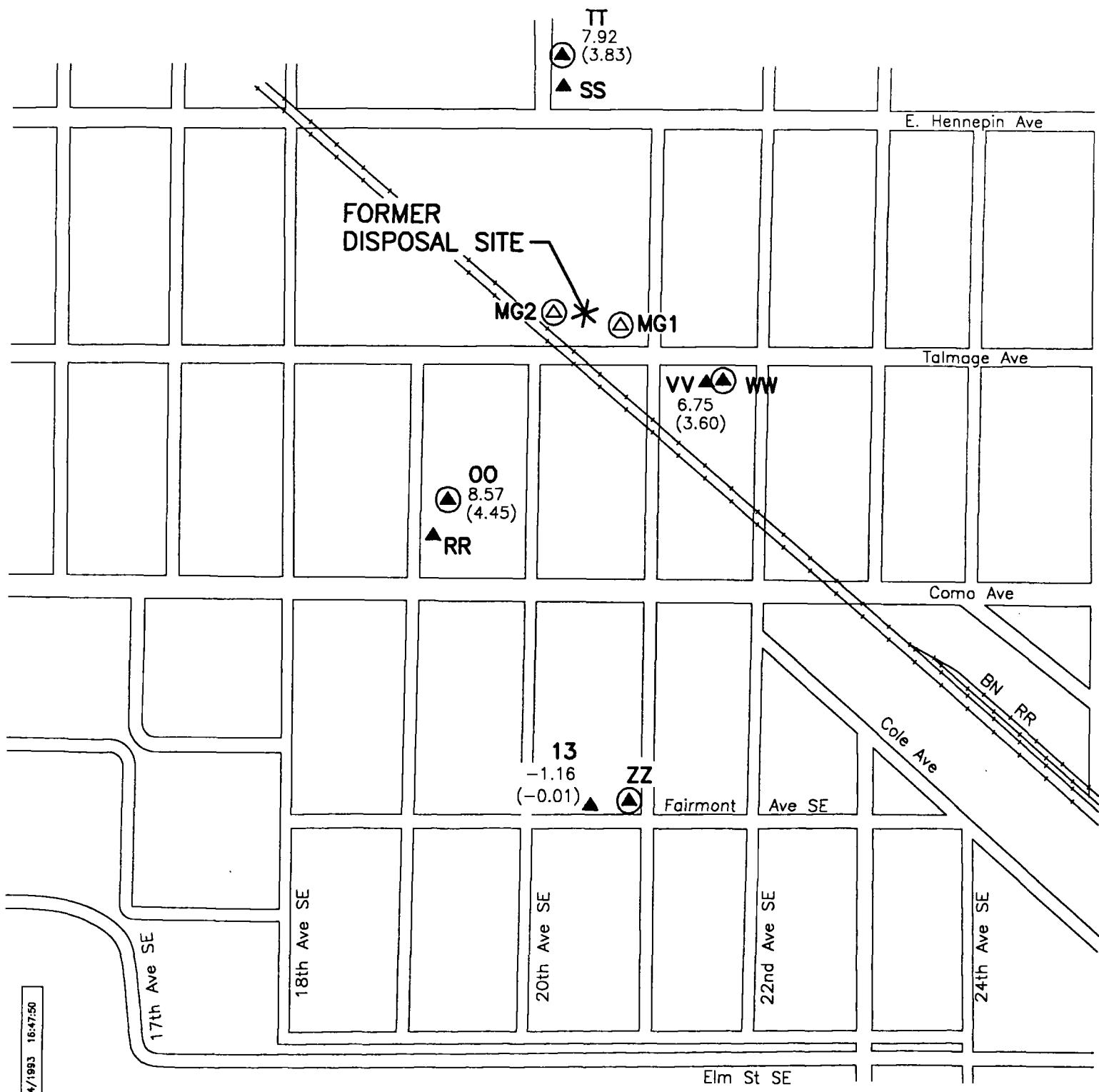
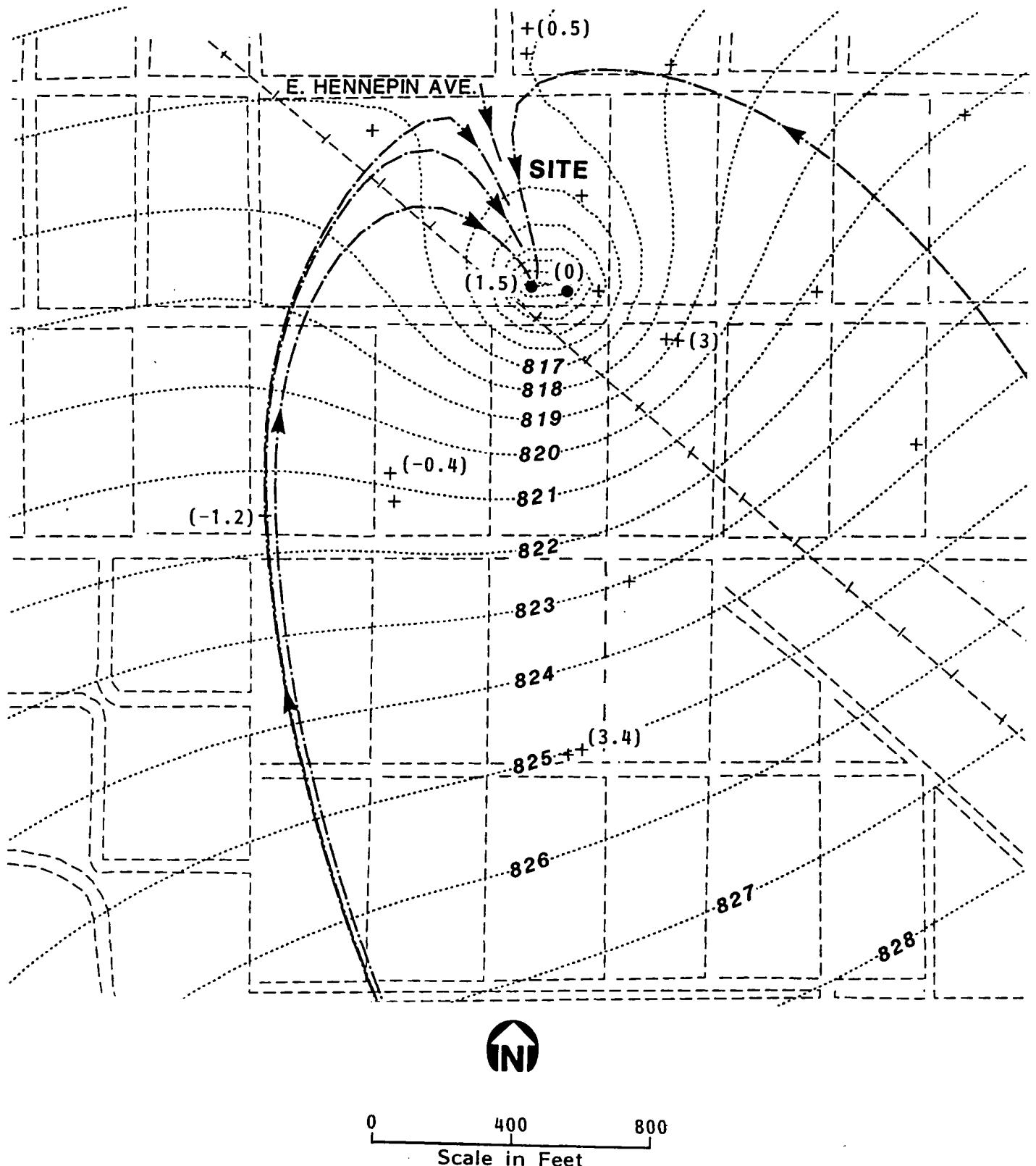


Figure 39

WATER LEVEL DIFFERENCE BETWEEN
NESTED WELLS AT END OF START-UP
MONITORING PERIOD
OCTOBER 1, 1992



(1.5) Difference between Measured Water Level (11/2/92)
and Predicted Water Level

Figure 40
SLAEM SIMULATION OF CAPTURE ZONE
Of MG1 and MG2
Each Pumping at 95 gpm

Appendices

Appendix A

*QA/QC Data
and Validation*

APPENDIX A
QUALITY ASSURANCE/QUALITY CONTROL DATA
AND VALIDATION

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TABLE A-1	1992 Blank Sample Data
TABLE A-2	1992 Blind Duplicate Data

APPENDIX A

QUALITY ASSURANCE/QUALITY CONTROL DATA AND VALIDATION

INTRODUCTION

A review of quality control data was conducted to assess the integrity of the sampling procedures and analytical results for samples collected from January through November 1992. The quality control data included analytical results from samples collected to determine both internal and external quality control. Internal quality control included initial and ongoing programs of quality assurance performed by CH₂M Hill Quality Analytical Laboratory (CH₂M Hill) in accordance with their laboratory Quality Assurance/Quality Control Plan. External quality control involved the collection and analysis of field blank samples and masked duplicate samples according to procedures described in the Groundwater Monitoring Quality Control/Quality Assurance Plan submitted to the MPCA in February 1985.

CH₂M Hill analyzed the 1992 water samples for volatile organic compounds (VOCs) according to EPA Methods 601/602 and priority pollutant VOCs with tentatively identified compounds according to EPA Method 624.

The Minnesota Department of Health (MDH) requires that laboratories conducting analytical tests for wastewater parameters (including VOCs) be certified by the MDH. CH₂M Hill is a certified environmental laboratory in the state of Minnesota with Laboratory ID No. 001-99-250.

INTERNAL QUALITY CONTROL

Intra-laboratory quality control procedures were conducted on a daily basis to determine the acceptability of the analytical results. Internal quality control procedures followed in the analysis of samples for volatile organic compounds included spiking 10 percent of the samples with reference standards and calculating the percent recovery; analyzing 10 percent of the samples in duplicate; and, analyzing daily laboratory blanks to check for system contamination.

Accuracy of the analytical data was assessed by evaluating percent recovery in spiked samples. CH₂M Hill uses statistical control procedures to establish and track data accuracy.

Data precision was assessed by evaluating laboratory duplicate analyses or duplicate spike samples analyses. A duplicate analysis is a replicate of a separate aliquot of the sample which has been taken through the same preparation procedures as the original sample. The relative percent difference (RPD) was computed for each duplicate set of results. Quality control data generated during the analysis of samples demonstrated acceptable precision.

Laboratory deionized water blanks were analyzed periodically throughout the analysis of samples. Laboratory blanks are used to evaluate possible system contamination.

Methylene chloride and trichloroethylene were detected in the laboratory blank associated with the priority pollutant analysis from May 1992 (Table 16). The laboratory qualified these results with a "j" indicating that these concentrations are estimates because the concentrations are less than the laboratory reporting limits. U.S. Environmental Protection Agency guidance (Laboratory Data Validation Functional Guidelines for Evaluating Organic Analysis, February 1988) for the evaluation of organic analysis data specifies that in cases where common laboratory contaminants (such as methylene chloride and acetone) are detected, the data must be qualified by raising the detection limit to ten times the reported blank concentration. In this case, application of the guidance has the effect of raising the detection limit of methylene chloride to 10 µg/L and the detection limit of trichloroethylene to 20 µg/L. This report qualifies data in accordance with these guidelines, with the exception of qualifying the data as "false positive" rather than "not detected at a higher detection limit". The false positives are qualified with a "b" in the data tables.

EXTERNAL QUALITY CONTROL

External quality control procedures were used to assess laboratory precision and accuracy and the effect of sample bottle preparation and handling processes on the quality of the analytical results. Procedures included the analysis of field blanks for detection of contamination introduced

during sample collection, and masked duplicate samples as a check on the reproducibility of the analytical results.

Four field blanks were collected and analyzed for volatile organic compounds. The results are presented in Table A-1. No volatile organic compounds were detected in the field blanks collected during 1992.

Seven samples were collected in duplicate and the results of the analysis are shown in Table A-2. The precision of the masked duplicate samples were evaluated by computing the RPD for each volatile organic compound. The RPD for each duplicate pair are summarized in Table A-2. Water quality data are considered indeterminate values when the RPD exceeds 25 percent for a parameter. RPDs for tetrachloroethane, trichloroethylene, toluene, and xylenes for the influent exceed the 25 percent advisory limit. However, because the sample characteristics of the influent matrix may vary significantly, these results are considered acceptable.

Appendix A

Tables

TABLE A-1
1992 BLANK SAMPLE DATA
(concentrations in ug/L)

	METHOD BLANKS						
	01/03/92	05/12/92	05/12/92	05/12/92	05/13/92	05/13/92	05/13/92
1,1-Dichloroethane	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethylene, cis	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethylene, trans	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2,2-Tetrachloroethane	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethylene	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	--	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethylene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzene	--	--	--	--	--	--	--
Toluene	--	--	--	--	--	--	--
Xylenes	--	--	--	--	--	--	--
	METHOD BLANKS						
	05/14/92	05/14/92	05/15/92	06/01/92	08/26/92	08/26/92	11/03/92
1,1-Dichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
1,2-Dichloroethylene, cis	<1.0	<1.0	<1.0	<1.0	--	--	<0.5
1,2-Dichloroethylene, trans	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
1,2-Dichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
1,1,2,2-Tetrachloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
Tetrachloroethylene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
1,1,1-Trichloroethane	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
Trichloroethylene	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
Benzene	<1.0	<1.0	<1.0	--	--	--	<0.5
Toluene	<1.0	<1.0	<1.0	--	--	--	<0.5
Xylenes	<1.0	<1.0	<1.0	--	--	--	<0.5
	METHOD BLANKS		TRAVEL BLANKS				
	11/04/92	11/05/92	01/03/92	05/13/92	08/26/92	11/05/92	11/05/92
1,1-Dichloroethane	<0.5	<0.5	--	<1.0	<1.0	--	<0.5
1,2-Dichloroethylene, cis	<0.5	<0.5	--	<1.0	--	--	<0.5
1,2-Dichloroethylene, trans	<0.5	<0.5	--	<1.0	<1.0	--	<0.5
1,2-Dichloroethane	<0.5	<0.5	--	<1.0	<1.0	--	<0.5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	--	<1.0	<1.0	--	<0.5
Tetrachloroethylene	<0.5	<0.5	--	<1.0	<1.0	--	<0.5
1,1,1-Trichloroethane	<0.5	<0.5	--	<1.0	<1.0	--	<0.5
Trichloroethylene	<0.5	<0.5	<1.0	<1.0	<1.0	<0.5	<0.5
Benzene	<0.5	<0.5	--	--	--	--	<0.5
Toluene	<0.5	<0.5	--	--	--	--	<0.5
Xylenes	<0.5	<0.5	--	--	--	--	<0.5
	FIELD BLANKS						
	01/03/92	05/13/92	05/14/92	11/05/92			
1,1-Dichloroethane	--	<1.0	<1.0	--			
1,2-Dichloroethylene, cis	--	<1.0	<1.0	--			
1,2-Dichloroethylene, trans	--	<1.0	<1.0	--			
1,2-Dichloroethane	--	<1.0	<1.0	--			
1,1,2,2-Tetrachloroethane	--	<1.0	<1.0	--			
Tetrachloroethylene	--	<1.0	<1.0	--			
1,1,1-Trichloroethane	--	<1.0	<1.0	--			
Trichloroethylene	<1.0	<1.0	<1.0	<0.5			
Benzene	--	--	--	--			
Toluene	--	--	--	--			
Xylenes	--	--	--	--			

-- Not analyzed.

.018

12/09/92

TABLE A-2
1992 BLIND DUPLICATE DATA
(concentrations in ug/L)

	EFF		RPD	3		RPD
	01/03/92 Sample	01/03/92 Duplicate		05/12/92 Sample	05/12/92 Duplicate	
1,1-Dichloroethane	--	--		3.8	4.3	12
1,2-Dichloroethylene, cis	--	--		25	29	15
1,2-Dichloroethylene, trans	--	--		<1.0	<1.0	0
1,2-Dichloroethane	--	--		<1.0	<1.0	0
1,1,2,2-Tetrachloroethane	--	--		<1.0	<1.0	0
Tetrachloroethylene	--	--		2.8	3.0	7
1,1,1-Trichloroethane	--	--		1.4	1.7	19
Trichloroethylene	<1.0	<1.0	0	400	370	7.8
Benzene	--	--		--	--	
Toluene	--	--		--	--	
Xylenes	--	--		--	--	
Sum Volatile Organics	ND	ND		430	410	

	T		RPD	202		RPD
	05/13/92 Sample	05/13/92 Duplicate		05/14/92 Sample	05/14/92 Duplicate	
1,1-Dichloroethane	<1.0	<1.0	0	<1.0	<1.0	0
1,2-Dichloroethylene, cis	<1.0	<1.0	0	<1.0	<1.0	0
1,2-Dichloroethylene, trans	<1.0	<1.0	0	<1.0	<1.0	0
1,2-Dichloroethane	<1.0	<1.0	0	<1.0	<1.0	0
1,1,2,2-Tetrachloroethane	<1.0	<1.0	0	<1.0	<1.0	0
Tetrachloroethylene	<1.0	<1.0	0	<1.0	<1.0	0
1,1,1-Trichloroethane	<1.0	<1.0	0	<1.0	<1.0	0
Trichloroethylene	<1.0	<1.0	0	<1.0	<1.0	0
Benzene	--	--		--	--	
Toluene	--	--		--	--	
Xylenes	--	--		--	--	
Sum Volatile Organics	ND	ND		ND	ND	

-- Not analyzed.

ND Not detected.

j Reported value is less than the detection limit.

3,.001

12/09/92

TABLE A-2 (cont.)

1992 BLIND DUPLICATE DATA
(concentrations in ug/L)

	INF		RPD	MGEFF		RPD
	05/14/92	05/14/92		11/03/92	11/03/92	
	Sample	Duplicate		Sample	Duplicate	
1,1-Dichloroethane	<1.0	5	0	40.5	40.5	0
1,2-Dichloroethylene, cis	48	--		40.5	40.5	0
1,2-Dichloroethylene, trans	<1.0	--		40.5	40.5	0
1,2-Dichloroethane	2.4	3 j	22	40.5	40.5	0
1,1,2,2-Tetrachloroethane	<1.0	2 j	0	40.5	40.5	0
Tetrachloroethylene	4.6	6	26	40.5	40.5	0
1,1,1-Trichloroethane	5.4	5	7.7	40.5	40.5	0
Trichloroethylene	320	470	38	32	29	9.8
Benzene	<1.0	28	193	40.5	40.5	0
Toluene	140	70	67	40.5	40.5	0
Xylenes	36	22	48	40.5	40.5	0
Sum Volatile Organics	560	710		32	29	

	ZZ		RPD
	11/05/92	11/05/92	
	Sample	Duplicate	
1,1-Dichloroethane	--	--	
1,2-Dichloroethylene, cis	--	--	
1,2-Dichloroethylene, trans	--	--	
1,2-Dichloroethane	--	--	
1,1,2,2-Tetrachloroethane	--	--	
Tetrachloroethylene	--	--	
1,1,1-Trichloroethane	--	--	
Trichloroethylene	96	97	1.0
Benzene	--	--	
Toluene	--	--	
Xylenes	--	--	
Sum Volatile Organics	96	97	

-- Not analyzed.

ND Not detected.

j Reported value is less than the detection limit.

3,.001

12/09/92

Appendix B

Historical Water Elevation and Water Quality Data

APPENDIX B

HISTORICAL WATER ELEVATION AND WATER QUALITY DATA

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TABLE B-1
 HISTORICAL WATER ELEVATION DATA
 GLACIAL DRIFT WELLS
 (elevations in feet/MSL)

	1	3	4	106	107
DATE	-----	-----	-----	-----	-----
02/82	843.19	--	--	--	--
02/82	842.37	--	--	--	--
03/82	842.37	--	--	--	--
03/82	842.28	--	--	--	--
03/82	842.29	835.95	833.20	--	--
04/82	842.54	836.07	833.30	--	--
04/82	842.54	836.07	833.35	--	--
11/82	843.70	836.48	833.89	--	--
02/83	842.96	836.16	833.53	--	--
04/83	843.44	836.88	834.11	840.25	840.19
06/83	842.90	837.58	834.88	839.40	839.25
09/83	--	836.95	834.38	838.80	838.68
11/83	--	--	--	838.57	--
01/84	--	--	--	839.40	837.36
01/84	--	--	--	838.48	838.41
03/84	--	837.23	834.20	838.68	838.65
10/85	842.68	836.57	--	838.52	838.42
12/85	842.38	835.19	833.40	837.12	836.96
07/87	842.0	832.75	--	--	--
10/87	842.34	834.30	--	--	--
04/88	841.90	832.89	830.23	835.63	835.54
07/88	841.69	832.45	--	--	--
10/88	841.77	833.00	--	--	--
04/89	841.74	833.30	830.79	--	835.34
07/89	841.75	833.76	--	--	--
10/89	841.72	833.98	--	--	--
05/90	--	833.65	830.43	--	--
07/90	841.90	834.35	--	836.36	836.17
10/90	841.69	834.15	--	--	--
04/91	841.36	832.92	--	--	--
09/91	842.02	834.25	--	--	--
05/92	841.96	834.19	--	--	--
11/92	841.98	834.02	--	--	--

-- Not measured.

2,.012

TABLE B-1 (cont.)

HISTORICAL WATER ELEVATION DATA
GLACIAL DRIFT WELLS

(elevations in feet/MSL)

DATE	B	Q	R	S	T
10/81	843.31	--	--	--	--
02/82	844.45	--	--	--	--
02/82	842.78	--	--	--	--
02/82	842.77	--	--	--	--
03/82	842.84	--	--	--	--
03/82	842.72	--	--	--	--
03/82	842.68	--	--	--	--
03/82	824.89	--	--	--	--
04/82	842.96	--	--	--	--
04/82	843.03	--	--	--	--
04/82	843.03	--	--	--	--
04/82	843.14	--	--	--	--
11/82	843.56	--	--	--	--
12/82	843.59	--	--	--	--
02/83	843.30	--	--	--	--
04/83	844.13	--	--	--	--
06/83	844.37	--	--	--	--
09/83	844.14	--	--	--	--
11/83	844.01	--	--	--	--
01/84	843.93	--	--	--	--
02/84	--	830.49	827.64	829.85	832.38
03/84	844.13	832.08	829.15	831.21	833.89
10/85	843.89	831.58	829.00	832.00	833.96
12/85	843.86	831.22	828.73	830.95	833.37
07/87	--	--	DRY	824.91	831.74
10/87	--	--	--	826.36	832.72
04/88	843.38	826.86	--	824.94	831.80
07/88	--	826.46	DRY	824.63	832.44
10/88	--	826.77	DRY	824.92	833.03
04/89	843.17	827.45	DRY	825.23	832.25
07/89	--	827.95	DRY	825.55	832.41
10/89	--	828.26	DRY	826.45	832.23
05/90	--	827.08	DRY	825.92	832.14
07/90	844.33	828.50	DRY	827.38	832.89
10/90	--	828.28	DRY	827.43	832.62
04/91	842.76	827.43	--	825.96	832.14
09/91	843.46	828.90	--	828.42	833.06
05/92	843.40	828.80	--	828.55	833.05
11/92	843.43	828.88	--	828.09	832.61

-- Not measured.

2,.012

TABLE B-1 (cont.)

HISTORICAL WATER ELEVATION DATA
GLACIAL DRIFT WELLS

(elevations in feet/MSL)

DATE	U	V	W	X
02/84	837.07	--	--	--
03/84	838.82	818.16	818.25	829.00
10/85	838.11	818.61	818.49	831.59
12/85	837.30	817.99	817.96	829.02
07/87	--	815.3	814.4	DRY
10/87	--	815.93	816.10	--
04/88	835.58	814.51	814.59	DRY
07/88	--	814.03	814.03	DRY
10/88	--	814.44	814.54	DRY
04/89	835.72	814.19	814.34	DRY
07/89	--	814.77	814.86	822.05
10/89	--	815.16	815.26	DRY
05/90	835.86	814.64	814.38	822.07
07/90	--	816.65	816.75	822.95
10/90	--	816.70	816.80	823.08
04/91	835.35	815.60	815.69	DRY
09/91	836.54	818.19	818.18	824.25
05/92	836.50	817.77	817.81	823.41
11/92	836.21	817.27	817.44	824.05

-- Not measured.

2,012

TABLE B-2
 HISTORICAL WATER ELEVATION DATA
 CARIMONA MEMBER WELLS
 (elevations in feet/MSL)

DATE	8	9	10	11	12	13
11/82	828.91	--	--	--	--	--
04/83	836.76	--	--	--	--	--
06/83	835.81	--	--	--	--	--
09/83	838.68	--	--	--	--	--
09/83	835.51	--	--	--	--	--
03/84	830.15	830.15	830.21	830.18	831.43	830.21
10/85	830.58	830.61	830.62	830.65	832.11	830.01
12/85	829.71	830.05	829.86	829.73	831.50	829.25
07/87	827.10	827.3	827.28	827.26	827.83	826.49
10/87	828.79	828.69	828.72	828.79	828.63	828.14
04/88	827.71	827.85	827.86	827.74	828.12	827.05
07/88	824.91	825.12	825.07	824.97	825.40	824.36
10/88	826.83	826.98	826.99	826.86	826.61	826.17
04/89	827.13	827.37	827.37	827.16	827.20	826.63
07/89	825.41	825.64	825.59	825.43	826.18	824.74
10/89	827.32	827.52	827.82	827.37	826.70	826.78
05/90	827.06	827.38	827.26	827.31	827.52	826.65
07/90	827.92	828.18	828.10	827.84	826.73	827.20
10/90	828.38	828.59	828.58	828.41	828.23	827.78
04/91	828.63	828.84	828.83	828.70	828.92	828.06
09/91	829.19	829.40	829.40	829.15	828.46	828.55
05/92	828.87	829.02	829.01	828.93	829.26	828.29
11/92	828.81	828.98	829.03	828.85	827.60	828.23

-- Not measured.

2,.011

TABLE B-2 (cont.)

HISTORICAL WATER ELEVATION DATA
CARIMONA MEMBER WELLS

(elevations in feet/MSL)

	108 (1)	BB	RR	SS	UU	WW
DATE						
10/81	--	828.09	--	--	--	--
11/81	--	827.85	--	--	--	--
02/82	--	829.87	--	--	--	--
02/82	--	827.85	--	--	--	--
02/82	--	827.77	--	--	--	--
03/82	--	827.85	--	--	--	--
03/82	--	828.61	--	--	--	--
03/82	--	827.81	827.73	--	--	--
03/82	--	827.76	827.73	--	--	--
04/82	--	827.89	827.76	--	--	--
04/82	--	827.82	--	--	--	--
04/82	--	827.82	827.57	--	--	--
04/82	--	828.08	828.17	--	--	--
11/82	--	829.07	829.12	835.43	828.85	828.91
12/82	--	829.18	829.22	835.67	831.10	829.08
02/83	--	828.89	828.98	834.07	828.98	828.76
02/83	--	--	834.25	--	--	--
04/83	--	829.69	829.72	834.13	829.54	829.48
06/83	--	829.96	829.97	834.29	829.86	829.77
09/83	--	829.66	829.53	823.15	829.55	829.45
11/83	830.12	830.15	830.08	833.90	830.24	829.95
01/84	--	829.84	--	833.55	829.80	829.69
01/84	830.65	830.12	828.99	833.50	830.02	829.94
03/84	830.92	830.25	830.16	832.34	830.18	830.08
10/85	830.77	830.26	830.19	831.76	830.63	830.60
12/85	812.90	829.76	829.90	830.59	829.88	829.79
07/87	805.9	--	827.11	826.18	--	--
10/87	806.06	--	828.82	827.27	--	--
04/88	804.57	827.81	827.85	826.22	827.72	827.71
07/88	804.45	--	825.11	824.05	--	--
10/88	804.49	--	826.95	825.37	--	--
04/89	807.81	827.34	827.35	825.54	827.31	827.31
07/89	804.51	--	825.65	823.62	--	--
10/89	827.49	--	827.57	825.12	--	--
05/90	--	--	827.41	824.77	827.28	827.27
07/90	804.54	828.01	827.98	827.05	--	--
10/90	804.64	--	828.48	826.74	--	--
04/91	807.87	828.75	828.76	826.42	828.69	828.66
09/91	804.55	829.25	829.41	826.95	829.23	831.23
01/92	830.22	--	--	--	--	--
05/92	805.36	828.93	829.08	826.42	828.92	828.89
11/92	829.22	828.65	829.01	824.50	828.93	828.86

(1) Carimona pump-out well.
-- Not measured.

2,.011

TABLE B-3

HISTORICAL WATER ELEVATION DATA
MAGNOLIA MEMBER WELLS

(elevations in feet/MSL)

DATE	OO	OO	TT	W	ZZ	(1) MG1	(1) MG2
03/82	823.60	823.25	--	--	--	--	--
03/82	823.60	823.34	--	--	--	--	--
03/82	823.48	823.29	--	--	--	--	--
04/82	823.64	823.37	--	--	--	--	--
04/82	823.72	823.42	--	--	--	--	--
04/82	823.99	823.75	--	--	--	--	--
11/82	824.96	824.61	822.41	825.57	--	--	--
12/82	824.79	824.41	822.59	825.76	--	--	--
02/83	825.51	823.57	822.34	825.50	--	--	--
02/83	--	--	822.62	--	--	--	--
04/83	825.29	823.00	822.90	826.32	--	--	--
06/83	825.80	825.61	823.60	826.43	--	--	--
09/83	824.71	825.20	829.55	826.18	--	--	--
11/83	825.69	825.44	823.44	826.52	--	--	--
01/84	825.46	--	823.26	826.32	--	--	--
03/84	825.78	825.61	823.54	826.64	830.2	--	--
02/85	--	--	822.62	--	--	--	--
10/85	825.76	825.46	823.26	826.99	830.67	--	--
12/85	825.57	825.39	822.74	826.24	830.65	--	--
02/86	824.74	824.49	822.10	825.60	830.05	--	--
04/86	824.75	824.52	822.10	825.60	829.65	--	--
06/86	824.89	824.68	822.31	825.66	828.31	--	--
08/86	824.86	824.71	822.32	825.65	829.44	--	--
10/86	825.49	825.24	822.90	826.33	830.45	--	--
04/87	823.87	823.66	821.46	824.83	829.25	--	--
07/87	822.85	822.53	820.42	823.42	827.93	--	--
10/87	824.24	823.96	821.77	824.99	829.98	--	--
04/88	823.31	823.03	820.91	824.14	828.44	--	--
07/88	821.14	820.82	818.88	821.73	825.73	--	--
10/88	822.46	822.11	820.13	823.34	827.57	--	--
04/89	822.82	822.47	820.46	823.75	828.72	--	--
07/89	821.66	821.32	819.38	822.36	826.05	--	--
10/89	823.07	822.70	820.69	823.98	828.20	--	--
05/90	822.79	822.51	820.42	823.65	828.04	--	--
07/90	823.67	823.36	821.35	824.57	828.65	--	--
10/90	823.99	823.73	821.56	824.88	829.16	--	--
04/91	824.52	824.25	821.75	825.46	829.44	--	--
09/91	825.50	825.19	823.05	826.28	829.94	--	--
05/92	825.10	824.83	822.63	825.87	829.66	824.59	823.38
11/92	820.27	820.33	817.29	822.01	829.61	811.91	812.52

(1) Magnolia Pump-out well

-- Not measured.

*

2,.010

TABLE B-4

HISTORICAL WATER ELEVATION DATA
ST. PETER SANDSTONE WELLS

(elevations in feet/MSL)

	200	201	202	203
DATE	-----	-----	-----	-----
10/85	--	779.64	751.98	752.05
12/85	758.68	780.24	752.60	757.58
07/87	760.63	777.82	753.86	753.43
10/87	760.47	779.35	753.28	753.42
04/88	761.89	780.40	753.36	753.37
07/88	758.57	773.59	752.28	752.10
10/88	760.78	778.42	752.53	752.43
04/89	762.22	779.61	753.67	753.57
07/89	758.96	775.98	752.77	752.37
10/89	760.36	777.25	752.70	752.43
05/90	761.79	778.59	753.72	753.29
07/90	759.54	776.15	753.16	752.61
10/90	759.90	776.67	752.44	751.93
04/91	761.75	778.01	753.50	752.94
09/91	761.38	778.26	753.38	752.96
05/92	762.57	778.37	754.73	754.01
11/92	763.44	780.11	754.93	754.23

-- Not measured.

2,.013

TABLE B-5
 HISTORICAL WATER ELEVATION DATA
 GLACIAL DRIFT PUMP-OUT WELLS
 (elevations in feet/MSL)

	109 (1)	110 (1)	111 (2)	112 (2)	113 (2)
DATE	-----	-----	-----	-----	-----
10/85	837.21	835.62	829.25	829.10	829.20
12/85	828.19	829.11	828.83	828.59	828.77
07/87	831.26	829.63	816.75	811.67	814.24
10/87	829.94	828.98	813.70	814.64	815.68
04/88	828.90	823.37	808.70	811.81	813.00
07/88	831.00	822.35	815.35	807.91	812.63
10/88	829.99	829.52	815.62	811.68	813.15
04/89	831.41	828.90	818.43	811.80	817.22
05/90	--	830.71	818.20	807.67	817.96
07/90	827.27	831.02	819.07	811.77	818.80
10/90	829.63	831.51	819.23	811.03	819.12
04/91	826.58	826.60	817.98	808.26	817.91
09/91	830.56	829.33	820.19	--	820.27
01/92	826.56	828.73	819.50	812.12	819.42
05/92	827.20	829.41	819.34	812.17	820.21
11/92	827.67	830.60	820.15	815.62	820.43

-- Not measured due to restricted site access.
 (1) Site glacial drift pump-out wells.
 (2) Down-gradient glacial drift pump-out wells.

2,.012

TABLE B-6

HISTORICAL WATER QUALITY DATA
 GLACIAL DRIFT WELLS
 TRICHLOROETHENE

(concentrations in ug/L)

DATE	B	Q	R	S	T
04/82	6.0	--	--	--	--
12/82	1100	--	--	--	--
12/83	780	--	--	--	--
02/84	--	<1.3	670	770	<1.3
10/85	1200	20	1100	740	<0.3
12/85	1100	14	820	750	<0.8
02/86	1300	11	31	650	<0.5
04/86	1000	13	DRY	1100	<0.2
06/86	1100	4.7	160	930	<0.2
08/86	1000	5.6	DRY	880	<0.2
10/86	--	3.2	--	620	<0.2
11/86	830	--	--	--	--
04/87	800	2.6	DRY	650	<0.2
07/87	--	--	DRY	740	--
10/87	--	--	--	1000	--
04/88*	330	0.86	DRY	460	<0.50
07/88*	--	--	DRY	160	--
10/88*	--	--	DRY	110	--
04/89	250	1.1	DRY	860	<0.5
07/89	--	--	DRY	620	--
10/89	--	--	DRY	630	--
05/90	--	0.7	DRY	710	<0.5
07/90	330	--	DRY	200	--
10/90	--	--	DRY	770	--
04/91	340	0.7	--	870	<0.5
09/91	--	--	--	480	--
05/92	510	<1.0	--	510	<1.0
11/92	--	--	--	770	--

-- Not analyzed.

* The 1988 analytical data generated from Serco Laboratories has been determined to be unreliable due to laboratory equipment and method performance problems. This has been verified by split sample analysis by two independent laboratories during 1988. Other documentation including correspondence for Serco Laboratories justifying this decision to qualify the 1988 data exists in the project file.

2,.014

TABLE B-6 (cont.)

HISTORICAL WATER QUALITY DATA
 GLACIAL DRIFT WELLS
 TRICHLOROETHENE

(concentrations in ug/L)

DATE	1	3	4
04/82	6.0	780	4.5
12/83	27	800	380
10/85	1.4	1100	--
11/85	--	--	440
12/85	1.5	770	440
02/86	1.4 s	680	200
04/86	3.1	1200	210
06/86	8.1	1300	180
08/86	9.3	890	280
10/86	0.9	720	200
04/87	2.7	740	120
07/87	0.4	770	--
10/87	0.8	960	--
04/88*	<0.50	440	55
07/88*	0.5	140	--
10/88*	<0.50	98	--
04/89	0.8	320	55
07/89	0.6 s	340	--
10/89	0.5	530	--
05/90	--	520	77
07/90	0.8	770	--
10/90	<0.5	310	--
04/91	3.1	1500	--
09/91	1.3	300	--
05/92	2.2	400	--
11/92	0.5	170	--

-- Not analyzed.

s Potential false positive value based on data validation procedures.

* The 1988 analytical data generated from Serco Laboratories has been determined to be unreliable due to laboratory equipment and method performance problems. This has been verified by split sample analysis by two independent laboratories during 1988. Other documentation including correspondence for Serco Laboratories justifying this decision to qualify the 1988 data exists in the project file.

2,.016

TABLE B-6 (cont.)

HISTORICAL WATER QUALITY DATA
GLACIAL DRIFT WELLS
TRICHLOROETHENE

(concentrations in ug/L)

DATE	U	V	W	X
02/84	<1.3	--	--	--
03/84	--	78	7.5	2.2
10/85	2.6	220	8.1	2.1
12/85	3.9	140	32	5.0
02/86	2.9	180	14	0.9 s
04/86	3.2	170	18	0.9
06/86	1.6	97	10	0.9
08/86	16	130	18	0.7
10/86	1.4	92	6.2	0.5
04/87	2.7	160	24	--
07/87	--	180	42	--
10/87	--	140	56	--
04/88*	--	160	43	DRY
07/88*	--	33	8.1	--
10/88*	--	37	26	--
04/89	--	130	57	DRY
07/89	--	120	22	--
10/89	--	120	25	--
05/90	--	110	31	DRY
07/90	--	120	<0.5	--
10/90	--	110	11	--
04/91	2.0	130	40	--
09/91	--	73	20	--
05/92	<1.0	63	5.9	<1.0
11/92	--	83	1.3	--

-- Not analyzed.

s Potential false positive value based on data validation procedures.

* The 1988 analytical data generated from Serco Laboratories has been determined to be unreliable due to laboratory equipment and method performance problems. This has been verified by split sample analysis by two independent laboratories during 1988. Other documentation including correspondence for Serco Laboratories justifying this decision to qualify the 1988 data exists in the project file.
2.015

TABLE B-7

HISTORICAL WATER QUALITY DATA
CARIMONA MEMBER WELLS
TRICHLOROETHENE

(concentrations in ug/L)

DATE	BB	RR	SS	UU	WW
05/82	--	46	--	--	--
06/82	1600	--	--	--	--
12/82	1600	43	<0.05	78	2100
12/83	1400	33	<1.5	81	1700
10/85	1900	110	0.4 s	150	2300
12/85	1100	95	1.2	79	1200
02/86	1300	88	<0.5	71	740
04/86	2200	170	0.4	81	540
06/86	2100	85	0.3	37	290
08/86	1800	100	0.3	45	220
10/86	--	--	<0.2	36	--
11/86	1300	100	--	--	290
04/87	1100	110	1.2	12	290
04/88*	530*	220	<0.50	23	320
04/89	340	180	1.3	38	530
05/90	--	60	4.1	35	450
07/90	530	--	--	--	--
04/91	1100	150	4.5	64	420
09/91	--	--	--	--	--
05/92	870	90	2.2	23	700

-- Not analyzed.

s Potential false positive value based on data validation procedures.

* The 1988 analytical data generated from Serco Laboratories has been determined to be unreliable due to laboratory equipment and method performance problems. This has been verified by split sample analysis by two independent laboratories during 1988. Other documentation including correspondence for Serco Laboratories justifying this decision to qualify the 1988 data exists in the project file.

2,.017

TABLE B-7 (cont.)

HISTORICAL WATER QUALITY DATA
CARIMONA MEMBER WELLS
TRICHLOROETHENE

(concentrations in ug/L)

DATE	8	9	10	11	12	13	108
04/83	820	--	--	--	--	--	--
11/83	--	--	--	--	--	--	1100
12/83	96	<0.05	2.6	120	<1.5	--	--
01/84	--	--	--	--	--	--	1100
03/84	--	--	--	--	--	25	--
10/85	2300	17	1500	2.7	--	1.9	--
11/85	--	--	--	--	<0.2	--	1500
12/85	650	10	1100	520	<0.8	21	820
02/86	240	6.7	420	250	<0.5	9.7	700
04/86	180	8.0	290	120	0.5	120	750
06/86	140	6.1	280	58	<0.2	130	640
08/86	160	6.7	270	67	0.2	14	580
10/86	110	5.4	220	40	<0.2	0.5	540
04/87	86	5.1	120	160	<0.2	140	450
07/87	--	0.6	150	25	<0.2	--	580
10/87	--	9.5	170	180	<0.5	--	560
04/88*	160	4.5	56	79	<0.5	<0.50	200
07/88*	--	1.7	34	0.3	<0.5	--	96
10/88*	--	10	58	0.7	1.0 s	--	87
04/89	380	9.8	160	110	<0.5	110	530
07/89	--	9.9	99	3.6	2.1	--	340
10/89	--	12	140	5.0	<0.5	--	--
12/89	--	--	--	--	--	--	490
05/90	100	8.5	150	<0.5	0.7	110	570
07/90	--	43	180	16	<0.5	--	400
10/90	--	9.4	130	240	<0.5	--	420
04/91	80	7.3	110	8.7	<0.5	<0.5	710
09/91	--	10	120	3.2	<0.5	--	76
05/92	47	3.2	58	190	<1.0	71	380
11/92	--	2.4	59	66	<0.5	--	--

s Potential false positive value based on data validation procedures.

-- Not analyzed.

* The 1988 analytical data generated from Serco has been determined to be unreliable due to laboratory equipment and method performance problems. This has been verified by split sample analysis by two independent laboratories during 1988. Other documentation including correspondence for Serco Laboratories justifying this decision to qualify the 1988 data exists in the project file.
2,005

TABLE B-8

HISTORICAL WATER QUALITY DATA
MAGNOLIA MEMBER WELLS
TRICHLOROETHENE

(concentrations in ug/L)

DATE	OO	QQ	TT	W	ZZ
05/82	15	--	--	--	--
06/82	--	13	--	--	--
12/82	56	13	8.9	--	--
03/84	--	--	--	--	14
10/85	49	2.9	26	140	85
12/85	31	7.3	19	93	28
02/86	36	5.2	27	92	200
04/86	120	6.0	53	280	440
06/86	27	1.0	20	83	91
08/86	19	0.6	40	99	39
10/86	32	6.4	23	77	190
04/87	130	2.5	34	63	230
04/88*	160	<0.50	16	63	130
07/88*	20	--	--	9.4	--
10/88*	34	--	--	25	43
04/89	90	3.7	30	59	180
07/89	70	--	--	87	34
10/89	67	--	--	150	33
05/90	58	3.4	26	33	120
07/90	62	--	--	27	61
10/90	30	--	--	46	36
04/91	5.1	<0.5	140	75	170
09/91	5.0	--	--	48	--
05/92	3.1	--	58	60	88
06/92	--	4.7	--	--	--
11/92	17	--	6.4	29	96

-- Not analyzed.

* The 1988 analytical data generated from Serco Laboratories has been determined to be unreliable due to laboratory equipment and method performance problems. This has been verified by split sample analysis by the independent laboratories during 1988. Other documentation including correspondence for Serco Laboratories justifying this decision to qualify the 1988 data exists in the project file.

2,007

TABLE B-9

HISTORICAL WATER QUALITY DATA
 ST. PETER SANDSTONE WELLS
 TRICHLOROETHENE

(concentrations in ug/L)

	200	201	202	203
DATE	-----	-----	-----	-----
10/85	..	0.5 s	..	..
11/85	120	..	2.6	0.5 s
12/85	100	2.9	2.0	1.2
02/86	72	<0.5	1.9	2.5
04/86	130	<0.2	0.2	0.6
06/86	110	<0.2	0.2 s	0.5
08/86	110	<0.2	2.7	0.5
10/86	78	<0.2	<0.2	0.5
04/87	100	0.1	<0.2	0.7
07/87	120	..	..	..
10/87	160	..	..	..
04/88*	89	<0.50	<0.50	<0.50
07/88*	33	..	..	..
10/88*	56	..	..	..
04/89	150	<0.5	<0.5	2.1
07/89	130	..	..	..
10/89	120	..	..	..
05/90	110	<0.5	0.8	2.8
07/90	11	..	..	..
10/90	130	..	..	..
04/91	140	<0.5	<0.5	3.0
09/91	77	..	..	..
05/92	61	<1.0	<1.0	1.2
11/92	64	..	..	..

s Potential false positive value based on data validation procedures.

.. Not analyzed.

* The 1988 analytical data generated from Serco Laboratories has been determined to be unreliable due to laboratory equipment and method performance problems. This has been verified by split sample analysis by two independent laboratories during 1988. Other documentation including correspondence from Serco Laboratories justifying this decision to qualify the 1988 data exists in the project file.
 2,008

TABLE B-10

HISTORICAL WATER QUALITY DATA
 PRAIRIE DU CHIEN/JORDAN WELL
 TRICHLOROETHENE

(concentrations in ug/L)

HENKEL	
DATE	
10/85	71
12/85	44
02/86	48
04/86	OFF
06/86	OFF
08/86	54
11/86	6.9
04/87	7.1
07/87	20
10/87	6.7
04/88*	13
07/88*	1.5
10/88*	8.0
04/89	12
07/89	10
10/89	11
07/91	49
09/91	18
05/92	31
11/92	<0.5

* The 1988 analytical data generated from Serco Laboratories has been determined to be unreliable due to laboratory equipment and method performance problems. This has been verified by split sample analysis by two independent laboratories during 1988 . Other documentation including correspondence for Serco Laboratories justifying this decision to qualify the 1988 data exists in the project file.
 2,.006

TABLE B-11

HISTORICAL WATER QUALITY DATA
 SITE PUMP-OUT AND TREATMENT SYSTEM
 DOWNGRADIENT PUMP-OUT SYSTEM
 TRICHLOROETHENE

(concentrations in ug/L)

DATE	(1) DISCHARGE	(2) INFLUENT	(3) EFFLUENT	(4) MG EFFLUENT
11/85	160	1200	13	--
12/85	140	870	12	--
01/86	--	1100	17	--
02/86	290	760	8.4	--
03/86	--	1700	14	--
04/86	400	860	11	--
06/86	250	--	--	--
08/86	350	870	6.7	--
10/86	190	610	1.0	--
03/87	320	730	6.8	--
04/87	170	530	8.3	--
07/87	310	660	2.8	--
10/87	230	720	<0.5	--
11/87	--	490	2.6	--
01/88*	300	470	4.4	--
04/88*	210	370	5.3	--
07/88*	70	160	1.2	--
10/88*	64	--	--	--
11/88*	--	84	3.7	--
01/89	210	390	9.8	--
04/89	200	440	13	--
07/89	170	380	20	--
10/89	110	--	--	--
12/89	--	140	190	--
01/90	140	380	96	--
05/90	220	370	1.2	--
07/90	180	310	0.9	--
10/90	100	360	2.9	--
01/91	150	430	0.8	--
04/91	290	890	1.0	--
07/91	210	370	<0.5	--
09/91	110	320	<0.5	--
01/92	99	260	<1.0	--
05/92	55	320	8.3	--
08/92	78	420	15	--
11/92	110	450	28	32

(1) Flow rate weighted composite sample (pump-out wells 111, 112, and 113)

(2) Flow rate weighted composite sample (pump-out wells 108, 109, and 110)

(3) Effluent from treatment system.

(4) Effluent from site pump-out wells MG1 and MG2.

-- Not analyzed.

* The 1988 analytical data generated from Serco Laboratories has been determined to be unreliable due to laboratory equipment and method performance problems. This has been verified by split sample analysis by two independent laboratories during 1988. Other documentation including correspondence for Serco Laboratories justifying this decision to qualify the 1988 data exists in the project file.

2,.009

Appendix C

Recommended 1993-1994 Monitoring Program

APPENDIX C

RECOMMENDED 1993-1994 OPERATION AND MONITORING PLAN

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APPENDIX C

RECOMMENDED 1993-1994 OPERATION AND MONITORING PLAN

INTRODUCTION

The following monitoring plan is recommended for the period January 1, 1993 through December 31, 1994 to fulfill the requirements of Section 1.9 of Part II of Exhibit A to the Order by Consent between General Mills, Inc. and the MPCA dated October 12, 1984. The recommended 1993-1994 Monitoring Plan is similar to the 1992 Monitoring Plan. Changes in the 1993-1994 Monitoring Plan include the use of former pump-out Well 108 as a Carimona Member monitoring location, and forming the composite influent sample from groundwater pumped from glacial drift Wells 109 and 110.

The 1993-1994 monitoring locations are shown on Figures C-1 through C-4. Water quality samples collected during the second quarter will be analyzed for volatile organic compounds presented in Table C-2. Water quality samples collected during the fourth quarter will be analyzed for TCE. Monitoring of site pump-out well effluent (109 and 110), downgradient pump-out well effluent (111, 112, and 113), Magnolia Member pump-out well effluent, and stripper tower effluent will be conducted according to NPDES Permit requirements. A summary of the sampling schedule, including monitoring activities and parameters for analysis, are presented by monitoring location and sampling period in Table C-1.

GROUNDWATER MONITORING

Glacial Drift

The following monitoring program will be conducted in 1993-1994 to monitor the effectiveness of the glacial drift pump-out systems:

- Water levels will be measured in Wells 1, 3, B, Q, S, T, U, V, W, X, 109, 110, 111, 112, and 113 during the second and fourth quarters.
- Samples will be collected from Wells 1, 3, B, Q, S, T, U, V, W, and X during the second quarter and analyzed for the List 1 compounds in Table C-2.
- Samples will also be collected from Wells 1, 3, S, V, and W during the fourth quarter and analyzed for TCE.

Carimona Member

The following monitoring program will be observed to determine the influence of the Magnolia Member pump-out system on the Carimona Member in the vicinity of the East Hennepin Avenue site:

- Water levels will be measured in Wells 8, 9, 10, 11, 12, 13, 108, BB, RR, SS, UU, and WW during the second, and fourth quarters.
- Samples will be collected from Wells 8, 9, 10, 11, 12, 13, 108, BB, RR, SS, UU, and WW during the second quarter and analyzed for the List 1 compounds in Table C-2.
- Samples will also be collected from Wells 9, 10, 11, 12, and 108 during the fourth quarter and analyzed for TCE.

Magnolia Member

The following monitoring program will be conducted to confirm the effectiveness of the Magnolia Member pump-out system in the vicinity of the East Hennepin Avenue site.

- Water levels will be measured in Wells MG1, MG2, OO, QQ, TT, VV, and ZZ during the second and fourth quarters.
- Samples will be collected from Wells OO, QQ, TT, VV, and ZZ, during the second quarter and analyzed for the List 1 compounds in Table C-2.
- Samples will also be collected from Wells OO, TT, VV, and ZZ during the fourth quarter and analyzed for TCE.

St. Peter Sandstone

- Water levels will be measured in Wells 200, 201, 202, and 203 during the second and fourth quarters.
- Samples will be collected from Wells 200, 201, 202, and 203 during the second quarter and analyzed for the List 1 compounds in Table C-2.
- Well 200 will be sampled in the fourth quarter and analyzed for TCE.

Prairie du Chien/Jordan (Henkel Well)

- Samples will be collected from the Henkel well during the second and fourth quarters and analyzed for the List 1 compounds in Table C-2.

Groundwater Pump-Out and Treatment Systems

- Samples will be collected from the site (glacial drift) pump-out system (109 and 110) during the first, second, third, and fourth quarters. Samples collected during the first and third quarters will be analyzed for TCE. Samples collected during the second quarter will be analyzed for the List 2 and List 3 compounds in Table C-2. Samples collected during the fourth quarter will be analyzed for the List 2 compounds in Table C-2.
- Samples will be collected from the effluent of the site groundwater treatment system during the first, second, third, and fourth quarters. Samples collected during the first and third quarters will be analyzed for TCE. Samples collected during the second and fourth quarters will be analyzed for the List 2 compounds in Table C-2.
- Samples will be collected from the downgradient glacial drift pump-out system effluent during the first, second, third, and fourth quarters. Samples collected during the first and third quarters will be analyzed for TCE. Samples collected during the second and fourth quarters will be analyzed for the List 2 compounds in Table C-2.
- Samples will be collected from the Magnolia Member pump-out system effluent during the first, second, third, and fourth quarters. Samples collected during the first and third quarters will be analyzed for TCE. Samples collected during the second and fourth quarters will be analyzed for the List 2 compounds in Table C-2.

MAGNOLIA MEMBER PUMP-OUT SYSTEM PERFORMANCE EVALUATION

A pump-out system performance evaluation will be performed on Magnolia Member Pump-Out Wells MG1 and MG2. The performance evaluation will be carried out in the third quarter and will consist of measuring the response of water levels in Carimona Member

Wells RR, SS, and VV and Magnolia Member Wells OO, TT, and WW when Wells MG1 and MG2 are shut down. Two cases will be evaluated: 1) when MG1 alone is restarted, and 2) when both MG1 and MG2 are restarted. In each case, three rounds of water level measurements will be collected: 1) before the system is shut off, 2) approximately 24 hours after the system is shut off, and 3) approximately 24 hours after the system is restarted. In each case, the pumps will be shut down for approximately a 24-hour period. A one week time period will separate the two performance evaluation tests.

Average pumping rates will be determined in each case for the three hour period prior to shut down and for the 24-hour period after start-up. The results of the water level and pumping rate measurements for each case will be compared with the results of the 1992 start-up monitoring to verify the pump-out system is operating effectively and to determine the effectiveness of a single pump-out well.

SYSTEM OPERATIONS AND MAINTENANCE

The following operations and maintenance program will be conducted to ensure that the glacial drift pump-out and groundwater treatment system and Magnolia Member pump-out system are operating effectively.

- Groundwater pumping rates in the glacial drift and Magnolia Member will be monitored monthly to determine if pump-out wells, pump-out well pipeline, or pump-out well pump maintenance is required.
- Pump-out well maintenance will occur on an as needed basis, and may include well redevelopment and well chlorination for control of bacterial growth.
- Pump-out well pipeline and appurtenance maintenance will occur on an as needed basis and may include repair of damaged pipeline, "pigging" of pipeline to remove bacterial growth, and repair or replacement of flow meters.

- Pump-out well pump maintenance will occur on an as needed basis and may include repair of an existing pump or replacement, and repair or replacement of the motor control and protection equipment.
- The groundwater treatment system (stripper tower) will be inspected periodically to evaluate the accumulation of calcium, magnesium, and iron precipitate on the packing material.
- Monitoring well maintenance will occur on an as needed basis and may include repair or replacement of well caps, repair or replacement of the protective posts surrounding the wells, and painting of the wells.

All maintenance of the groundwater pump-out and treatment systems will be conducted in a manner that minimizes down time for the system(s). The groundwater treatment system and site glacial drift pump-out system may be shut down periodically to provide for removal and replacement of stripper tower packing material (estimated once every three years).

REPORTING

Quarterly

General Mills Inc. will submit the analytical results to the MPCA Project Leader by the 15th day of the month following completion of all analyses of samples collected during the previous quarterly sampling event.

Monitoring Report

General Mills will submit a monitoring report for the previous two calendar years to the MPCA Project Leader on or before January 31, 1995. Each report will contain the following information:

- Results of all water level measurements and chemical analyses for the previous calendar years.
- Water level contour maps (if applicable) for each aquifer showing groundwater levels.
- Vertical cross sections of the glacial drift groundwater elevations between Wells 1 and W.
- Maps showing the sum of the List 1 compounds listed in Table C-2 for each well location monitored during the second quarter sampling events, and maps showing the TCE concentrations for the fourth quarter sampling events.
- A discussion and summary of the reporting year's data in comparison to previously available data.
- A proposed sampling plan for the next two monitoring years.

Appendix C

Tables

TABLE C-1
**RECOMMENDED 1993-1994 WATER LEVEL
 MONITORING LOCATIONS**

	<u>Monitoring Station</u>	<u>Apr-May Monitoring</u>	<u>Oct-Nov Monitoring</u>
Glacial Drift	1	WL ¹	WL
	3	WL	WL
	109 ²	WL	WL
	110 ²	WL	WL
	111 ²	WL	WL
	112 ²	WL	WL
	113 ²	WL	WL
	B	WL	WL
	Q	WL	WL
	S	WL	WL
	T	WL	WL
	U	WL	WL
	V	WL	WL
Carimona Member	W	WL	WL
	X	WL	WL
	8	WL	WL
	9	WL	WL
	10	WL	WL
	11	WL	WL
	12	WL	WL
	13	WL	WL
	108	WL	WL
	BB	WL	WL
	RR	WL	WL
	SS	WL	WL
	UU	WL	WL
Magnolia Member	WW	WL	WL
	MG1 ²	WL	WL
	MG2 ²	WL	WL
	OO	WL	WL
	QQ	WL	WL
	TT	WL	WL
	VV	WL	WL
St. Peter Sandstone	ZZ	WL	WL
	200	WL	WL
	201	WL	WL
	202	WL	WL
	203	WL	WL

¹Water level measurement

²Pump-out well

TABLE C-1 (Continued)

RECOMMENDED 1993-1994 MONITORING
STATIONS AND SAMPLING FREQUENCIES

	<u>Monitoring Station</u>	<u>Apr-May Parameter Monitoring</u>	<u>Oct-Nov Parameter Monitoring</u>
Glacial Drift	1	List 1 ³	TCE
	3	List 1	TCE
	B	List 1	--
	Q	List 1	--
	S	List 1	TCE
	T	List 1	--
	U	List 1	--
	V	List 1	TCE
	W	List 1	TCE
	X	List 1	--
Carimona Member	8	List 1	--
	9	List 1	TCE
	10	List 1	TCE
	11	List 1	TCE
	12	List 1	TCE
	13	List 1	--
	108	List 1	TCE
	BB	List 1	--
	RR	List 1	--
	SS	List 1	--
	UU	List 1	--
	WW	List 1	--
Magnolia Member	OO	List 1	TCE
	QQ	List 1	--
	TT	List 1	TCE
	VV	List 1	TCE
	ZZ	List 1	TCE
St. Peter Sandstone	200	List 1	TCE
	201	List 1	--
	202	List 1	--
	203	List 1	--
Prairie du Chien-Jordan	Henkel ⁵	List 1	List 1

³List 1 - Collection and analysis of water quality samples for List 1 parameters using EPA Method 601.

⁴TCE - Collection and analysis of water quality samples for trichloroethene (TCE) using EPA Method 601.

⁵Henkel - Collection of water quality samples dependent upon operation status of former Henkel Corporation well.

TABLE C-1 (Continued)

**RECOMMENDED 1993-1994 MONITORING
LOCATIONS AND SAMPLING FREQUENCIES**

	<u>Jan-Feb</u>	<u>Apr-May</u>	<u>Jul-Aug</u>	<u>Oct-Nov</u>
Influent (Pump-Out Wells 109 and 110)	TCE ⁴	List 2, ⁶ List 3 ⁷	TCE	List 2
Effluent (Pump-Out Wells 109 and 110)	TCE	List 2	TCE	List 2
Discharge (Pump-Out Wells 111, 112, 113)	TCE	List 2	TCE	List 2
Magnolia Pump-Out System Effluent (Pump-Out Wells MG1 and MG2)	TCE	List 2 ⁶	TCE	List 2

⁶List 2 - Collection and analysis of water quality samples for List 2 parameters using EPA Method 601/602.

⁷List 3 - Collection and analysis of water quality samples for List 3 parameters using EPA Method 624 with tentatively identified compounds (TIC).

TABLE C-2
**RECOMMENDED 1993-1994 WATER QUALITY
 ANALYTICAL PARAMETER LISTS**

List 1¹

Chlorinated Volatile Organics

1,1-Dichloroethane
 1,2-Dichloroethane
 1,2-Dichloroethylene, cis
 1,2-Dichloroethylene, trans
 1,1,2,2-Tetrachloroethane
 Tetrachloroethylene
 1,1,1-Trichloroethane
 Trichloroethene

List 2²

Chlorinated Volatile Organics

1,1-Dichloroethane
 1,2-Dichloroethane
 1,2-Dichloroethylene, cis
 1,2-Dichloroethylene, trans
 1,1,2,2-Tetrachloroethane
 Tetrachloroethylene
 1,1,1-Trichloroethane
 Trichloroethene

Non-Chlorinated Volatile Organics

Benzene
 Toluene
 Xylenes

List 3³

Priority Pollutant Volatile Organics

Acetone
 Benzene
 Bromodichloromethane
 Bromoform
 Bromomethane
 Carbondisulfide
 Carbon Tetrachloride
 Chlorobenzene
 Chloroethane
 2-Chloroethylvinyl Ether
 Chloroform
 Chloromethane
 Chlorodibromomethane
 1,2-Dichlorobenzene
 1,3-Dichlorobenzene
 1,4-Dichlorobenzene
 1,1-Dichloroethane
 1,2-Dichloroethane
 1,1-Dichloroethene
 1,2-Dichloroethene

1,2-Dichloropropane
 cis-1,3-Dichloropropane
 trans-1,3-Dichloro-1-propene
 Ethyl Benzene
 2-Hexanone
 Methylene Chloride
 Methyl Ethyl Ketone
 Methyl Isobutyl Ketone
 Styrene
 1,1,2,2-Tetrachloroethane
 Tetrachloroethene
 Toluene
 1,1,1-Trichloroethane
 1,1,2-Trichloroethane
 Trichloroethene
 Trichlorofluoromethane
 Vinyl Acetate (Vinyl Ester)
 Vinyl Chloride
 Xylenes

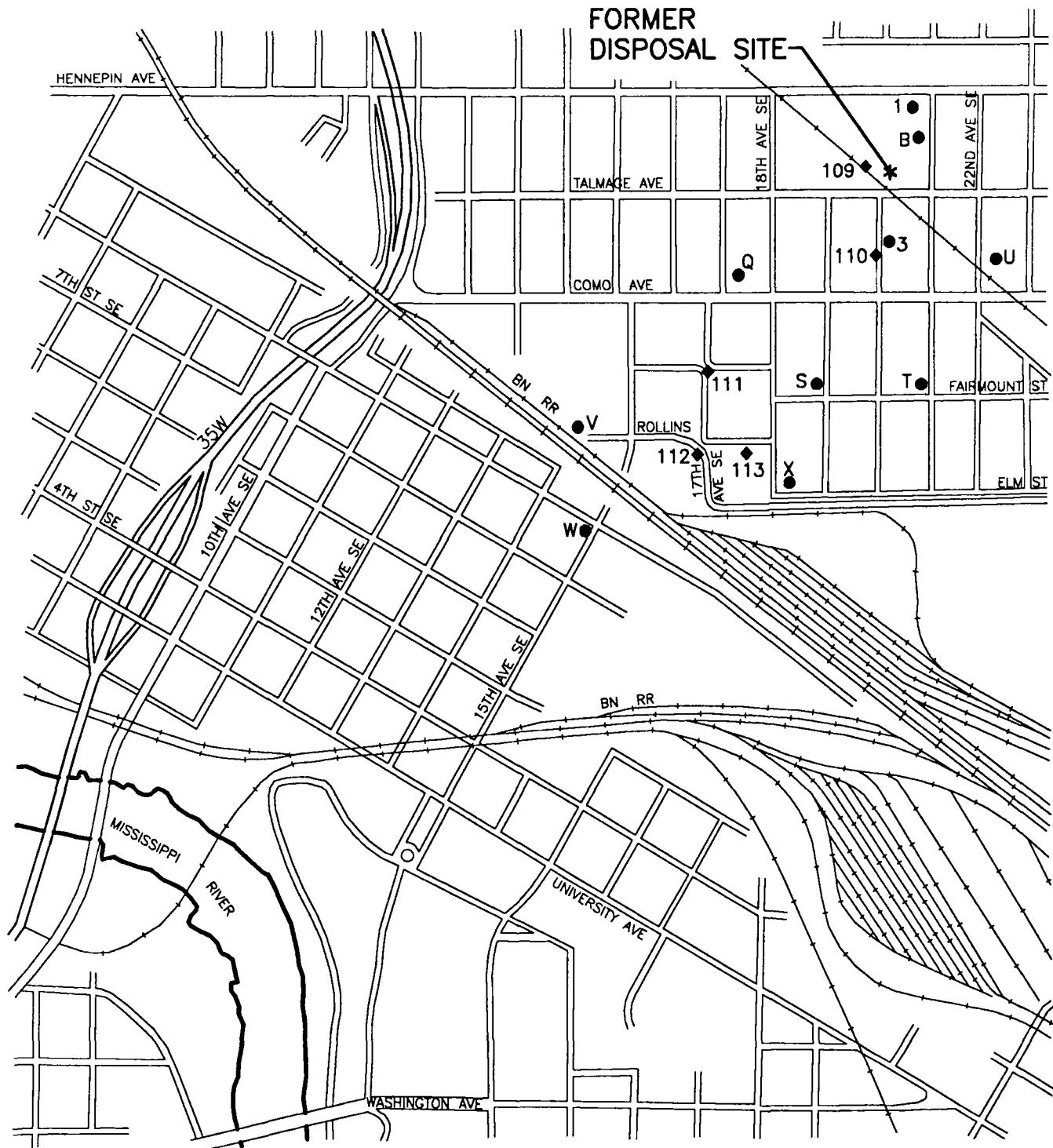
¹List 1 - Analyzed using EPA Method 601.

²List 2 - Analyzed using EPA Methods 601/602.

³List 3 - Analyzed using EPA Method 624 with tentatively identified compounds (TIC).

Appendix C

Figures

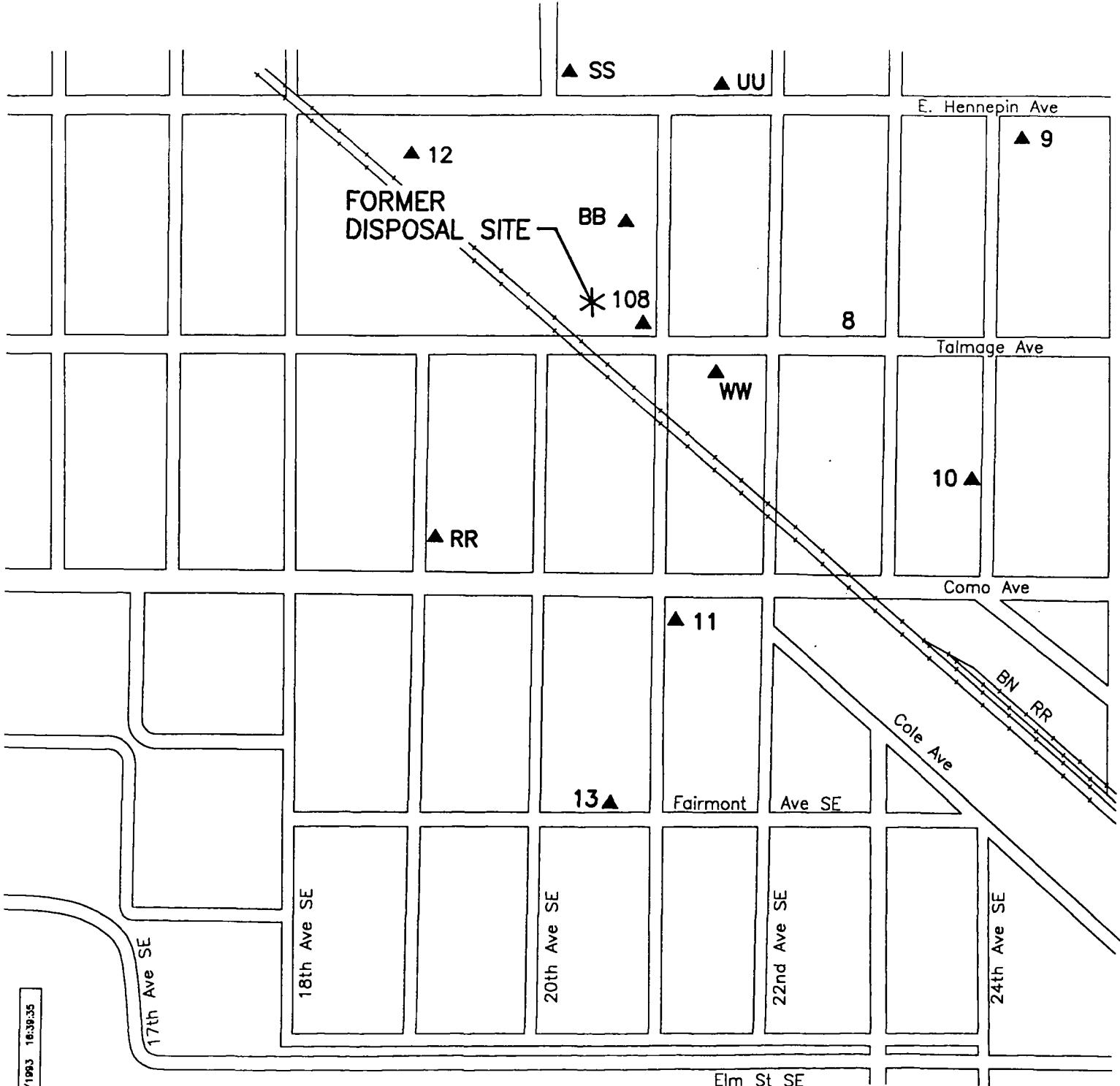


- GLACIAL DRIFT MONITORING WELL
- ◆ GLACIAL DRIFT PUMP-OUT WELL



0 1000
SCALE IN FEET

Figure C-1
GLACIAL DRIFT AQUIFER
1993-1994 MONITORING LOCATIONS

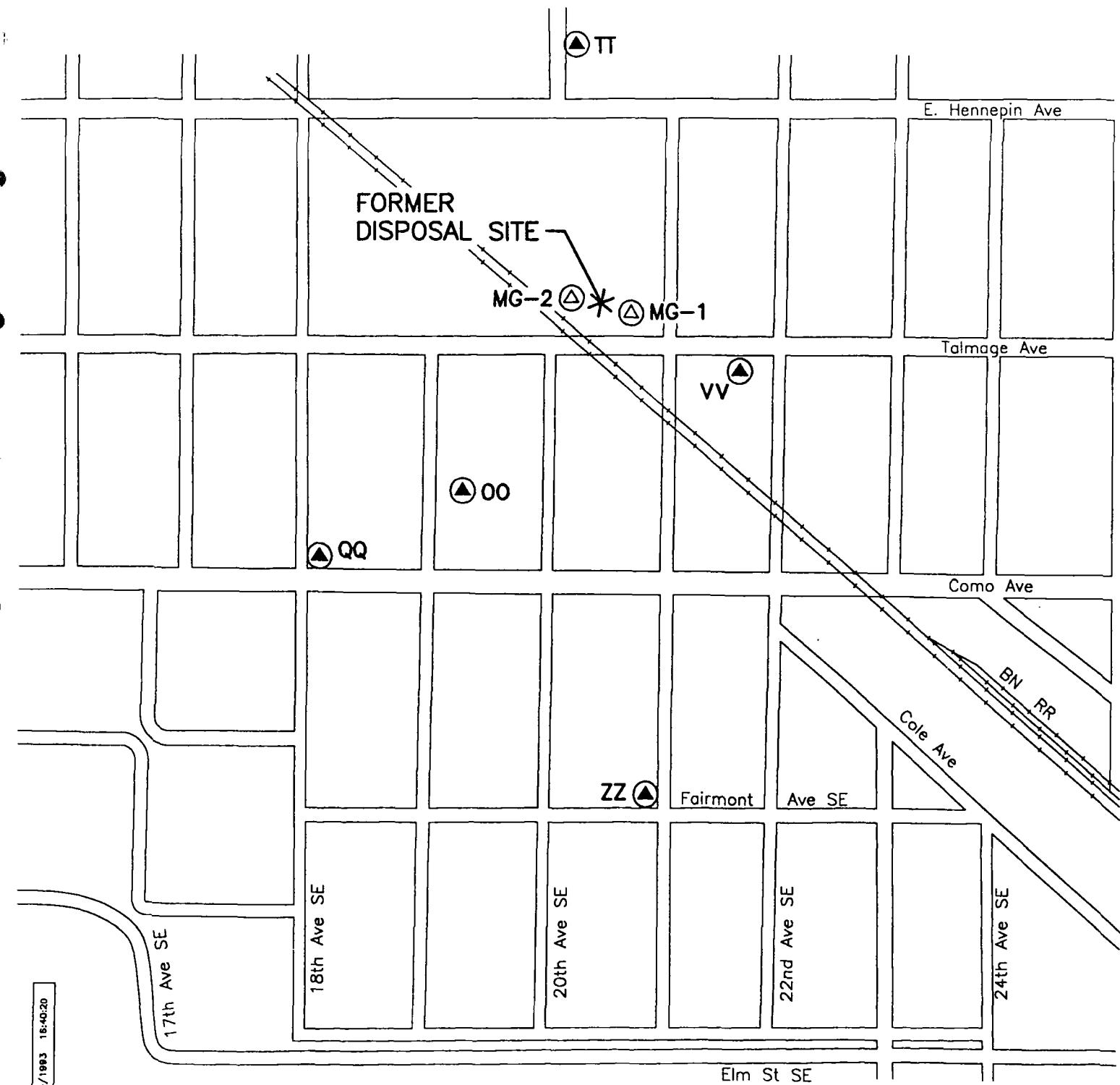


- ▲ CARIMONA MEMBER MONITORING WELL
- ◆ CARIMONA MEMBER PUMP-OUT WELL
(SHUT DOWN SEPTEMBER 1992)



0 200 400
SCALE IN FEET

Figure C-2
CARIMONA MEMBER
1993-1994 MONITORING LOCATIONS



- ▲ MAGNOLIA MEMBER MONITORING WELL
- △ MAGNOLIA MEMBER PUMP-OUT WELL

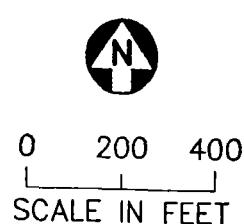


Figure C-3
MAGNOLIA MEMBER
1993-1994 MONITORING LOCATIONS

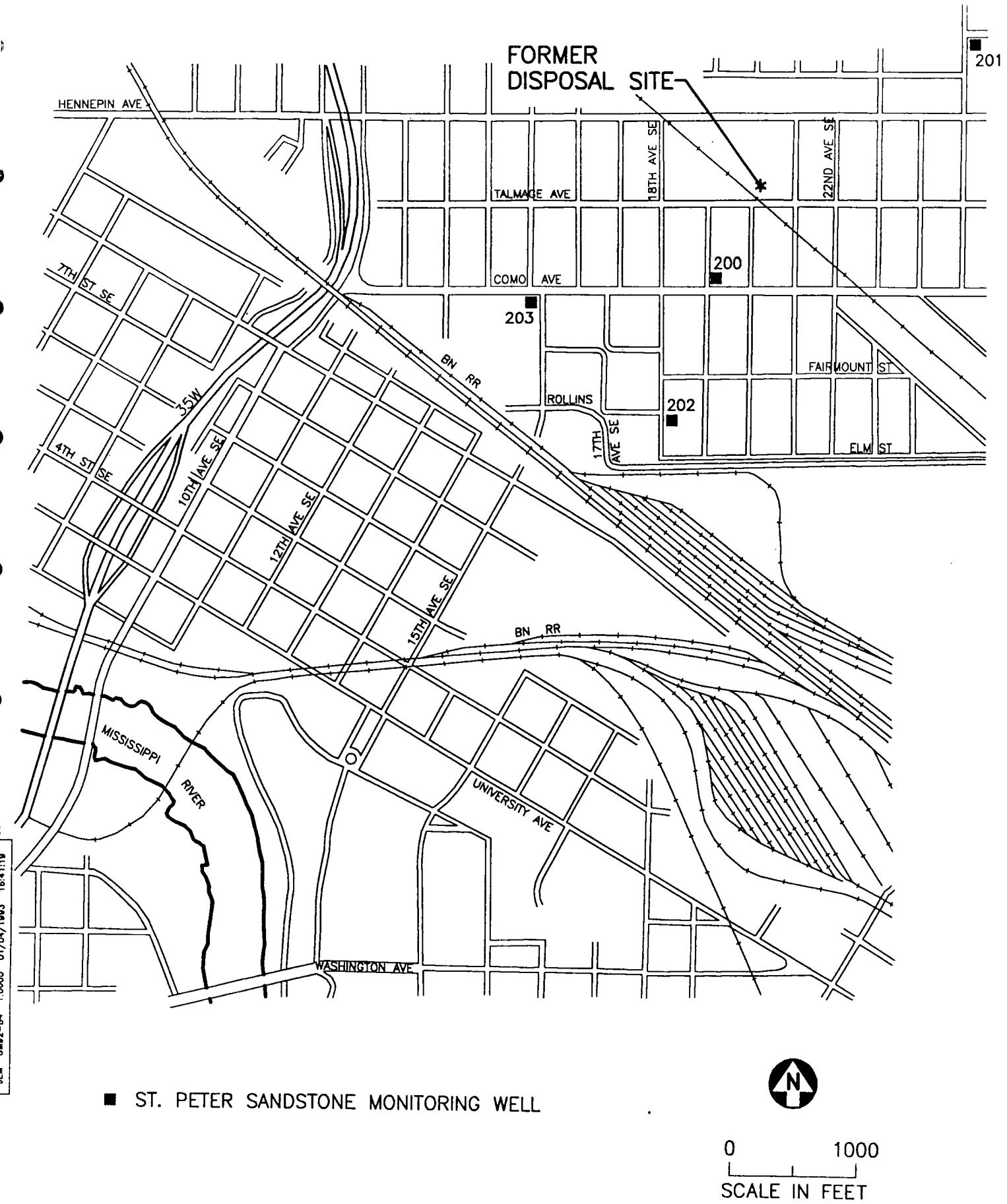


Figure C-4
ST. PETER SANDSTONE
1993-1994 MONITORING LOCATIONS

Appendix D

Magnolia Pump Test Data

TABLE D-1

Magnolia Pump-out Well Start-Up Monitoring Data
Water Levels in Pump-out Wells MG1 and MG2

Equipment Verification Readings:

MG-1

Date	Time	Manual Reading (ft BTOC)	Data Logger Output (ft BTOC)	Water Elevation (ft MSL)
09/22	12:08	35.02	NR	825.79
09/22	13:36	35.04	NR	825.77
09/22	15:07	35.04	35.01	825.77
09/22	08:08	34.84	34.74	825.97
09/23	08:58	34.85	34.76	825.96
09/23	10:32	39.72	39.70	821.09
09/23	10:47	39.92	39.92	820.89
09/23	10:47	50.40	49.04	810.41*
09/23	11:50	49.64	48.51	811.17
09/24	13:45	49.70	48.65	811.11
09/24	18:27	49.01	48.00	811.80
09/25	09:09	50.12	48.90	810.69
09/25	17:39	49.00	48.59	811.81
09/26	10:10	49.38	48.01	811.43
09/27	09:15	49.74	48.71	811.07
09/28	09:01	49.43	48.26	811.38
09/29	09:34	NR	48.35	
09/30	07:57	NR	48.13	

MG-2

Date	Time	Manual Reading (ft BTOC)	Data Logger Output (ft BTOC)	Water Elevation (ft MSL)
09/22	12:42	34.13	0.00	825.69
09/22	15:05	34.11	34.07	825.71
09/23	08:05	33.91	33.84	825.91
09/23	08:54	33.93	33.77	825.89
09/23	09:10	33.92	33.74	825.90
09/23	10:15	0.00	0.00	859.82
09/23	10:21	39.48	0.00	820.34
09/23	10:28	39.74	0.00	820.08
09/23	10:48	39.94	39.92	819.88
09/23	11:49	47.92	0.00	811.90
09/23	13:47	47.90	48.00	811.92
09/24	07:44	48.06	48.07	811.76
09/24	18:19	47.53	47.43	812.29

TABLE D-1 (Continued)

Magnolia Pump-out Well Start-Up Monitoring Data
Water Levels in Pump-out Wells MG1 and MG2

MG-2 (Continued)

Date	Time	Manual Reading (ft BTOC)	Data Logger Output (ft BTOC)	Water Elevation (ft MSL)
09/25	09:07	48.31	48.43	811.51
09/25	17:42	48.11	47.91	811.71
09/26	10:12	47.80	47.44	812.02
09/27	09:27	48.05	48.12	811.77
09/28	09:00	47.86	47.68	811.96
09/28	17:25	0.00	0.00	
09/29	09:34	0.00	47.90	
09/30	07:58	0.00	47.81	

Automatically Recorded Data:

TABLE D-2

**Magnolia Pump-out Well Start-Up Monitoring Data
Total Flow from Pump-out Wells MG1 and MG2**

MG1		
Date	Time	Total Flow (gallons)
09/23	11:45	300.00
09/23	12:26	1400.00
09/23	12:37	2460.00
09/23	13:41	8940.00
09/23	14:15	12380.00
09/23	15:23	19000.00
09/24	08:16	118800.00
09/24	18:27	174780.00
09/25	09:15	264250.00
09/25	17:32	314420.00
09/25	17:37	314900.00
09/25	17:45	315700.00
09/25	18:45	321550.00
09/16	10:05	410750.00
09/27	09:00	548910.00
09/27	10:16	556580.00
09/27	10:27	557150.00
09/28	08:45	685920.00
09/28	17:15	734630.00
09/29	09:27	827600.00
09/29	15:26	861860.00
09/30	07:52	956370.00
09/30	21:08	1032600.00
10/01	07:43	1093520.00

TABLE D-2 (Continued)

Magnolia Pump-out Well Start-Up Monitoring Data
Total Flow from Pump-out Wells MG1 and MG2

MG2		
Date	Time	Total Flow (gallons)
09/23	10:19	2554050.00
09/23	10:27	2554800.00
09/23	10:44	2556450.00
09/23	11:04	2558450.00
09/23	11:26	1560.00
09/23	11:45	3450.00
09/23	12:28	7580.00
09/23	12:38	8510.00
09/23	13:41	14660.00
09/23	14:16	17960.00
09/23	15:23	24500.00
09/24	08:18	122450.00
09/24	18:29	181780.00
09/25	09:16	267480.00
09/25	17:35	315530.00
09/26	10:05	411460.00
09/27	09:00	544810.00
09/28	08:53	684150.00
09/28	17:20	733200.00
09/29	09:30	827120.00
09/29	15:28	861800.00
09/30	07:54	957620.00
09/30	21:10	1034860.00
10/01	07:46	1096700.00

TABLE D-3

Magnolia Pump-out Well Start-Up Monitoring Data
Water Level Measurements in the Monitoring Wells

Well 8 (Carimona Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:47	30.88	829.48	0.00	0.00
09/23	08:32	30.62	829.74	-0.26	0.74
09/23	14:32	32.01	828.35	1.13	0.99
09/24	09:47	32.47	827.89	1.59	1.79
09/24	18:03	32.45	827.91	1.57	2.14
09/25	08:59	32.62	827.74	1.74	2.76
09/25	18:37	32.58	827.78	1.70	3.16
09/26	11:00	32.30	828.06	1.42	3.84
09/27	09:48	32.25	828.11	1.37	4.79
09/28	09:59	32.54	827.82	1.66	5.80
09/29	10:32	32.59	827.77	1.71	6.82
09/30	09:14	32.52	827.84	1.64	7.77
10/01	08:53	32.52	827.84	1.64	8.75

Well 9 (Carimona Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:23	32.78	829.70	0.00	0.00
09/23	07:43	32.54	829.94	-0.24	0.72
09/23	14:36	33.94	828.54	1.16	1.01
09/24	07:25	34.26	828.22	1.48	1.71
09/24	17:27	34.39	828.09	1.61	2.13
09/25	08:23	34.50	827.98	1.72	2.75
09/25	18:17	34.53	827.95	1.75	3.16
09/26	11:13	34.22	828.26	1.44	3.87
09/27	09:58	34.17	828.31	1.39	4.82
09/28	09:26	34.41	828.07	1.63	5.79
09/29	09:59	34.47	828.01	1.69	6.82
09/30	08:42	34.41	828.07	1.63	7.76
10/01	08:20	34.43	828.05	1.65	8.75

TABLE D-3 (Continued)

Magnolia Pump-out Well Start-Up Monitoring Data
Water Level Measurements in the Monitoring Wells

Well 10 (Carimona Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:14	30.72	829.67	0.00	0.00
09/23	07:48	30.47	829.92	-0.25	0.73
09/23	14:39	31.88	828.51	1.16	1.02
09/24	09:09	32.28	828.11	1.56	1.79
09/24	17:30	32.30	828.09	1.58	2.14
09/25	08:17	32.40	827.99	1.68	2.75
09/25	18:10	32.45	827.94	1.73	3.16
09/26	10:55	32.15	828.24	1.43	3.86
09/27	09:44	32.10	828.29	1.38	4.81
09/28	09:29	32.33	828.06	1.61	5.80
09/29	10:03	32.40	827.99	1.68	6.83
09/30	08:46	32.34	828.05	1.62	7.77
10/01	08:23	36.36			

Well 11 (Carimona Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:15	23.12	829.72	0.00	0.00
09/23	07:52	22.88	829.96	-0.24	0.73
09/23	14:44	24.29	828.55	1.17	1.02
09/24	09:16	24.69	828.15	1.57	1.79
09/24	17:55	24.68	828.16	1.56	2.15
09/25	08:38	24.83	828.01	1.71	2.77
09/25	18:14	24.85	827.99	1.73	3.17
09/26	10:45	24.54	828.30	1.42	3.85
09/27	09:39	24.50	828.34	1.38	4.81
09/28	09:40	24.75	828.09	1.63	5.81
09/29	10:07	24.81	828.03	1.69	6.83
09/30	08:50	24.73	828.11	1.61	7.77
10/01	08:33	24.77	828.07	1.65	8.76

TABLE D-3 (Continued)

Magnolia Pump-out Well Start-Up Monitoring Data
Water Level Measurements in the Monitoring Wells

Well 12 (Carimona Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:55	31.78	829.32	0.00	0.00
09/23	07:25	31.77	829.33	-0.01	0.69
09/23	15:18	31.79	829.31	0.01	1.02
09/24	08:45	31.86	829.24	0.08	1.74
09/24	17:03	31.90	829.20	0.12	2.09
09/25	08:09	31.97	829.13	0.19	2.72
09/25	17:52	32.01	829.09	0.23	3.12
09/26	NR	NR	NR		3.38
09/27	10:09	32.19	828.91	0.41	4.80
09/28	09:08	32.27	828.83	0.49	5.76
09/29	09:45	32.38	828.72	0.60	6.78
09/30	08:07	32.46	828.64	0.68	7.72
10/01	08:03	32.55	828.55	0.77	8.71

Well 13 (Carimona Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:11	20.19	829.06	0.00	0.00
09/23	07:56	19.95	829.30	-0.24	0.74
09/23	14:46	21.35	827.90	1.16	1.02
09/24	09:24	21.75	827.50	1.56	1.80
09/24	17:38	21.74	827.51	1.55	2.14
09/25	08:35	21.88	827.37	1.69	2.77
09/25	18:17	21.91	827.34	1.72	3.17
09/26	10:43	21.61	827.64	1.42	3.86
09/27	09:34	21.56	827.69	1.37	4.81
09/28	09:35	21.81	827.44	1.62	5.81
09/29	10:14	21.85	827.40	1.66	6.84
09/30	08:55	21.80	827.45	1.61	7.78
10/01	08:30	21.82	827.43	1.63	8.76

TABLE D-3 (Continued)

Magnolia Pump-out Well Start-Up Monitoring Data
Water Level Measurements in the Monitoring Wells

Well BB (Carimona Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	13:47	34.92	829.69	0.00	0.00
09/23	08:24	34.70	829.91	-0.22	0.78
09/23	14:23	36.21	828.40	1.29	1.03
09/24	08:05	36.65	827.96	1.73	1.76
09/24	18:15	36.69	827.92	1.77	2.19
09/25	09:02	36.87	827.74	1.95	2.80
09/25	18:41	36.82	827.79	1.90	3.20
09/26	10:17	36.69	827.92	1.77	3.85
09/27	10:14	36.50	828.11	1.58	4.85
09/28	09:06	36.71	827.90	1.79	5.80
09/29	09:39	36.76	827.85	1.84	6.83
09/30	08:02	36.62	827.99	1.70	7.76
10/01	07:57	36.73	827.88	1.81	8.76

Well OO (Magnolia Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:00	24.38	825.69	0.00	0.00
09/23	08:38	24.19	825.88	-0.19	0.78
09/23	14:54	30.28	819.79	5.90	1.04
09/24	09:32	30.43	819.64	6.05	1.81
09/24	17:50	30.33	819.74	5.95	2.16
09/25	08:43	30.73	819.34	6.35	2.78
09/25	18:23	30.56	819.51	6.18	3.18
09/26	10:32	30.32	819.75	5.94	3.86
09/27	09:27	30.40	819.67	6.02	4.81
09/28	09:43	30.50	819.57	6.12	5.82
09/29	10:19	30.50	819.57	6.12	6.85
09/30	08:59	30.44	819.63	6.06	7.79
10/01	08:38	30.43	819.64	6.05	8.78

TABLE D-3 (Continued)

Magnolia Pump-out Well Start-Up Monitoring Data
Water Level Measurements in the Monitoring Wells

Well QQ (Magnolia Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	13:54	23.58	825.43	0.00	0.00
09/23	08:45	23.40	825.61	-0.18	0.79
09/23	14:59	29.18	819.83	5.60	1.05
09/24	09:43	29.33	819.68	5.75	1.83
09/24	17:43	29.33	819.68	5.75	2.16
09/25	08:48	29.61	819.40	6.03	2.79
09/25	18:27	29.44	819.57	5.86	3.19
09/26	10:36	29.22	819.79	5.64	3.86
09/27	09:29	29.28	819.73	5.70	4.82
09/28	09:49	29.39	819.62	5.81	5.83
09/29	10:22	29.41	819.60	5.83	6.85
09/30	09:04	29.32	819.69	5.74	7.80
10/01	08:42	29.32	819.69	5.74	8.78

Well RR (Carimona Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:02	20.16	829.81	0.00	0.00
09/23	08:39	19.90	830.07	-0.26	0.78
09/23	14:52	21.33	828.64	1.17	1.03
09/24	09:31	21.73	828.24	1.57	1.81
09/24	17:48	21.72	828.25	1.56	2.16
09/25	08:42	21.90	828.07	1.74	2.78
09/25	18:22	21.88	828.09	1.72	3.18
09/26	10:28	21.57	828.40	1.41	3.85
09/27	09:25	21.55	828.42	1.39	4.81
09/28	09:45	21.81	828.16	1.65	5.82
09/29	10:18	21.82	828.15	1.66	6.84
09/30	09:00	21.75	828.22	1.59	7.79
10/01	08:36	21.76	828.21	1.60	8.77

TABLE D-3 (Continued)

Magnolia Pump-out Well Start-Up Monitoring Data
Water Level Measurements in the Monitoring Wells

Well SS (Carimona Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:30	34.39	827.31	0.00	0.00
09/23	07:32	34.17	827.53	-0.22	0.71
09/23	15:06	37.27	824.43	2.88	1.02
09/24	08:55	37.40	824.30	3.01	1.77
09/24	17:11	37.36	824.34	2.97	2.11
09/25	08:13	37.48	824.22	3.09	2.74
09/25	17:59	37.45	824.25	3.06	3.15
09/26	11:15	37.18	824.52	2.79	3.86
09/27	10:05	37.14	824.56	2.75	4.82
09/28	09:16	37.20	824.50	2.81	5.78
09/29	09:52	37.21	824.49	2.82	6.81
09/30	08:13	37.11	824.59	2.72	7.74
10/01	08:10	37.13	824.57	2.74	8.74

Well TT (Magnolia Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:29	38.72	823.22	0.00	0.00
09/23	07:31	38.50	823.44	-0.22	0.71
09/23	15:05	45.46	816.48	6.74	1.02
09/24	08:54	45.42	816.52	6.70	1.77
09/24	17:08	45.38	816.56	6.66	2.11
09/25	08:15	45.71	816.23	6.99	2.74
09/25	17:57	45.61	816.33	6.89	3.14
09/26	11:18	45.34	816.60	6.62	3.87
09/27	10:04	45.40	816.54	6.68	4.82
09/28	09:15	45.38	816.56	6.66	5.78
09/29	09:49	45.37	816.57	6.65	6.81
09/30	08:11	45.27	816.67	6.55	7.74
10/01	08:06	45.29	816.65	6.57	8.73

TABLE D-3 (Continued)

Magnolia Pump-out Well Start-Up Monitoring Data
Water Level Measurements in the Monitoring Wells

Well UU (Carimona Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:36	34.25	829.73	0.00	0.00
09/23	07:36	33.99	829.99	-0.26	0.71
09/23	15:11	35.50	828.48	1.25	1.02
09/24	09:00	35.80	828.18	1.55	1.77
09/24	17:16	35.85	828.13	1.60	2.11
09/25	08:19	35.95	828.03	1.70	2.74
09/25	18:03	35.99	827.99	1.74	3.14
09/26	11:11	35.68	828.30	1.43	3.86
09/27	10:01	35.63	828.35	1.38	4.81
09/28	09:21	35.87	828.11	1.62	5.78
09/29	09:55	35.94	828.04	1.69	6.80
09/30	08:16	35.83	828.15	1.58	7.74
10/01	08:14	35.88	828.10	1.63	8.73

Well VV (Magnolia Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:41	32.53	826.56	0.00	0.00
09/23	08:27	32.33	826.76	-0.20	0.74
09/23	14:27	37.50	821.59	4.97	0.99
09/24	09:52	37.74	821.35	5.21	1.80
09/24	18:08	37.61	821.48	5.08	2.14
09/25	08:53	38.05	821.04	5.52	2.76
09/25	18:32	37.84	821.25	5.31	3.16
09/26	11:03	37.60	821.49	5.07	3.85
09/27	09:51	37.65	821.44	5.12	4.80
09/28	09:53	37.82	821.27	5.29	5.80
09/29	10:27	37.84	821.25	5.31	6.82
09/30	09:08	37.78	821.31	5.25	7.77
10/01	08:46	37.76	821.33	5.23	8.75

TABLE D-3 (Continued)

Magnolia Pump-out Well Start-Up Monitoring Data
Water Level Measurements in the Monitoring Wells

Well WW (Carimona Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:43	28.05	829.71	0.00	0.00
09/23	08:29	27.81	829.95	-0.24	0.74
09/23	14:29	29.17	828.59	1.12	0.99
09/24	09:57	29.63	828.13	1.58	1.80
09/24	18:10	29.59	828.17	1.54	2.14
09/25	08:55	29.79	827.97	1.74	2.76
09/25	18:34	29.75	828.01	1.70	3.16
09/26	11:05	29.47	828.29	1.42	3.85
09/27	09:54	29.41	828.35	1.36	4.80
09/28	09:55	29.69	828.07	1.64	5.80
09/29	10:29	29.76	828.00	1.71	6.82
09/30	09:19	29.68	828.08	1.63	7.77
10/01	08:49	29.68	828.08	1.63	8.75

Well ZZ (Magnolia Member Well)

Date	Time	Manual Reading (ft BTOC)	Water Elevation (ft MSL)	Draw- down (ft)	Elapsed Time (days)
09/22	14:08	20.02	830.23	0.00	0.00
09/23	07:58	19.78	830.47	-0.24	0.74
09/23	14:38	21.19	829.06	1.17	1.02
09/24	09:23	21.58	828.67	1.56	1.80
09/24	17:36	21.57	828.68	1.55	2.14
09/25	08:33	21.70	828.55	1.68	2.77
09/25	18:18	21.74	828.51	1.72	3.17
09/26	10:46	21.44	828.81	1.42	3.86
09/27	09:36	21.41	828.84	1.39	4.81
09/28	09:34	21.64	828.61	1.62	5.81
09/29	10:12	21.69	828.56	1.67	6.84
09/30	08:53	21.64	828.61	1.62	7.78
10/01	08:28	21.66	828.59	1.64	8.76

TABLE D-4
Water Level Differences in Nested Monitoring Wells

	05/11/92	09/22/92	10/01/92	11/02/92
Well WW	828.89	829.71	828.08	828.86
Well VV	825.87	826.56	821.33	822.01
Difference	3.02	3.15	6.75	6.85
Well SS	826.42	827.31	824.57	824.50
Well TT	822.63	823.22	816.65	817.29
Difference	3.79	4.09	7.92	7.21
Well RR	829.08	829.81	828.21	829.01
Well OO	825.10	825.69	819.64	820.27
Difference	3.98	4.12	8.57	8.74
Well 13	828.29	829.06	827.43	828.23
Well TT	829.66	830.23	828.59	829.61
Difference	-1.37	-1.17	-1.16	NO NET EFFECT

Carimona Wells:

8
9
10
11
12
13
BB
RR
SS
UU
WW

Magnolia Wells:

OO
QQ
TT
VV
ZZ

MG-1 Raw Data**MG-2 Raw Data**

SE1000B

Environmental Logger
09/24 08:52

SE1000B

Environmental Logger
09/24 08:40

Unit# 00222 Test# 0

Unit# 00222 Test# 0

INPUT 1: Level (F) TOC INPUT 2: Level (F) TOC

Reference	35.04	Reference	33.97
Scale factor	20.01	Scale factor	20.11
Offset	- 0.06	Offset	0.00

Step# 0 09/22 13:30 Step# 0 09/22 13:30

Elapsed Time	Value	Elapsed Time	Value
0.0000	35.03	0.0000	34.28
15.0000	35.04	15.0000	34.28
30.0000	35.04	30.0000	34.28
45.0000	35.04	45.0000	34.28
60.0000	35.02	60.0000	34.26
75.0000	35.01	75.0000	34.25
90.0000	35.01	90.0000	34.26
105.000	35.01	105.000	34.24
120.000	34.98	120.000	34.21
135.000	34.96	135.000	34.19
150.000	34.95	150.000	34.18
165.000	34.94	165.000	34.17
180.000	34.92	180.000	34.14
195.000	34.86	195.000	34.12
210.000	34.87	210.000	34.12
225.000	34.84	225.000	34.10
240.000	34.84	240.000	34.10
255.000	34.83	255.000	34.09
270.000	34.84	270.000	34.10
285.000	34.85	285.000	34.11
300.000	34.83	300.000	34.10
315.000	34.81	315.000	34.07
330.000	34.79	330.000	34.05
345.000	34.78	345.000	34.04
360.000	34.76	360.000	34.02
375.000	34.74	375.000	34.02
390.000	34.73	390.000	34.00
405.000	34.72	405.000	33.99
420.000	34.71	420.000	33.98
435.000	34.71	435.000	33.98

Elapsed Time	Value	Elapsed Time	Value
450.000	34.70	450.000	33.97
465.000	34.69	465.000	33.97
480.000	34.70	480.000	33.97
495.000	34.68	495.000	33.95
510.000	34.67	510.000	33.95
525.000	34.67	525.000	33.95
540.000	34.67	540.000	33.94
555.000	34.66	555.000	33.93
570.000	34.66	570.000	33.93
585.000	34.66	585.000	33.93
600.000	34.64	600.000	33.93
615.000	34.64	615.000	33.92
630.000	34.64	630.000	33.91
645.000	34.63	645.000	33.91
660.000	34.62	660.000	33.90
675.000	34.62	675.000	33.90
690.000	34.62	690.000	33.90
705.000	34.61	705.000	33.89
720.000	34.61	720.000	33.88
735.000	34.61	735.000	33.88
750.000	34.61	750.000	33.88
765.000	34.61	765.000	33.88
780.000	34.61	780.000	33.85
795.000	34.60	795.000	33.88
810.000	34.60	810.000	33.87
825.000	34.59	825.000	33.86
840.000	34.59	840.000	33.86
855.000	34.59	855.000	33.86
870.000	34.59	870.000	33.86
885.000	34.58	885.000	33.85
900.000	34.57	900.000	33.85
915.000	34.57	915.000	33.84
930.000	34.57	930.000	33.84
945.000	34.57	945.000	33.84
960.000	34.57	960.000	33.84
975.000	34.57	975.000	33.84
990.000	34.57	990.000	33.84
1005.00	34.56	1005.00	33.84
1020.00	34.57	1020.00	33.84
1035.00	34.61	1035.00	33.88
1050.00	34.66	1050.00	33.93
1065.00	34.71	1065.00	33.98
1080.00	34.71	1080.00	33.99
1095.00	34.73	1095.00	34.00
1110.00	34.74	1110.00	34.02
1125.00	34.75	1125.00	34.03

Elapsed Time	Value	Elapsed Time	Value
1140.00	34.71	1140.00	33.98
1155.00	34.76	1155.00	33.97
1170.00	34.76	1170.00	33.96
END		END	

SE1000B Environmental Logger 09/24 08:53	SE1000B Environmental Logger 09/24 08:43
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Unit# 00222 Test# 1 Unit# 00222 Test# 1

INPUT 1: Level (F) TOC INPUT 2: Level (F) TOC

Reference	34.85	Reference	33.97
Scale factor	20.01	Scale factor	20.11
Offset	- 0.06	Offset	0.00

Step# 0 09/23 09:20 Step# 0 09/23 09:20

Elapsed Time	Value	Elapsed Time	Value
0.0000	34.85	0.0000	33.96
0.0033	34.85	0.0033	33.97
0.0066	34.83	0.0066	33.97
0.0099	34.83	0.0099	33.96
0.0133	34.85	0.0133	33.97
0.0166	34.85	0.0166	33.97
0.0200	34.85	0.0200	33.97
0.0233	34.83	0.0233	36.26
0.0266	34.83	0.0266	36.65
0.0300	34.90	0.0300	35.90
0.0333	35.51	0.0333	35.59
0.0500	35.28	0.0500	36.71
0.0666	35.69	0.0666	37.62
0.0833	36.15	0.0833	38.64
0.1000	36.60	0.1000	38.94
0.1166	36.99	0.1166	39.13
0.1333	37.36	0.1333	39.62
0.1500	37.64	0.1500	39.61
0.1666	37.85	0.1666	40.09
0.1833	38.04	0.1833	39.96
0.2000	38.21	0.2000	40.24
0.2166	38.35	0.2166	40.44
0.2333	38.50	0.2333	40.61
0.2500	38.64	0.2500	40.76

Elapsed Time	Value	Elapsed Time	Value
0.2666	38.74	0.2666	40.56
0.2833	38.85	0.2833	40.84
0.3000	38.97	0.3000	40.82
0.3166	39.05	0.3166	40.94
0.3333	39.13	0.3333	41.15
0.4167	39.30	0.4167	40.28
0.5000	38.84	0.5000	39.25
0.5833	38.69	0.5833	39.08
0.6667	38.58	0.6667	39.16
0.7500	38.54	0.7500	39.05
0.8333	38.55	0.8333	38.96
0.9167	38.60	0.9167	39.08
1.0000	38.67	1.0000	39.22
1.0833	38.86	1.0833	39.43
1.1667	38.96	1.1667	39.51
1.2500	39.01	1.2500	39.63
1.3333	39.04	1.3333	39.81
1.4166	39.09	1.4166	39.72
1.5000	39.13	1.5000	39.81
1.5833	39.17	1.5833	39.75
1.6667	39.22	1.6667	39.67
1.7500	39.26	1.7500	40.03
1.8333	39.31	1.8333	39.97
1.9167	39.35	1.9167	39.93
2.0000	39.39	2.0000	39.98
2.5000	39.56	2.5000	40.26
3.0000	36.54	3.0000	35.63
3.5000	35.81	3.5000	34.93
4.0000	35.52	4.0000	34.57
4.5000	35.36	4.5000	34.38
5.0000	35.25	5.0000	34.30
5.5000	35.18	5.5000	34.21
6.0000	35.12	6.0000	34.15
6.5000	35.05	6.5000	34.12
7.0000	35.08	7.0000	34.09
7.5000	35.02	7.5000	34.05
8.0000	34.98	8.0000	34.03
8.5000	34.94	8.5000	34.00
9.0000	34.91	9.0000	33.97
9.5000	34.91	9.5000	33.98
10.0000	34.89	10.0000	33.96
12.0000	41.44	12.0000	42.99
14.0000	42.20	14.0000	43.74
16.0000	42.65	16.0000	44.23
18.0000	37.34	18.0000	36.44
20.0000	36.00	20.0000	35.09

Elapsed Time	Value	Elapsed Time	Value
22.0000	36.12	22.0000	35.20
24.0000	35.58	24.0000	34.66
26.0000	35.44	26.0000	34.48
28.0000	40.30	28.0000	41.20
30.0000	41.72	30.0000	43.09
32.0000	42.45	32.0000	43.90
34.0000	38.53	34.0000	37.64
36.0000	36.28	36.0000	35.37
38.0000	41.45	38.0000	42.97
40.0000	42.73	40.0000	44.24
42.0000	43.16	42.0000	44.70
44.0000	43.41	44.0000	44.87
46.0000	36.98	46.0000	36.09
48.0000	36.29	48.0000	35.37
50.0000	36.68	50.0000	35.76
52.0000	36.03	52.0000	35.04
54.0000	35.81	54.0000	34.90
END		END	

SE1000B
Environmental Logger
09/24 08:54 **SE1000B**
Environmental Logger
09/24 08:44

Unit# 00222 Test# 1 Unit# 00222 Test# 1

INPUT 1: Level (F) TOC INPUT 2: Level (F) TOC

Reference	34.85	Reference	33.97
Scale factor	20.01	Scale factor	20.11
Offset	- 0.06	Offset	0.00

Step# 1 09/23 10:15 Step# 1 09/23 10:15

Elapsed Time	Value	Elapsed Time	Value
0.0000	35.73	0.0000	34.80
0.0033	35.73	0.0033	34.83
0.0066	35.73	0.0066	34.84
0.0099	35.72	0.0099	34.82
0.0133	35.72	0.0133	34.80
0.0166	35.72	0.0166	34.80
0.0200	35.72	0.0200	34.80
0.0233	35.72	0.0233	34.88
0.0266	35.72	0.0266	34.87
0.0300	35.72	0.0300	34.82

Elapsed Time	Value	Elapsed Time	Value
0.0333	35.72	0.0333	34.85
0.0500	35.72	0.0500	34.85
0.0666	35.72	0.0666	35.27
0.0833	36.06	0.0833	36.22
0.1000	36.23	0.1000	37.65
0.1166	36.66	0.1166	38.61
0.1333	37.09	0.1333	39.09
0.1500	37.52	0.1500	39.38
0.1666	37.87	0.1666	39.60
0.1833	38.16	0.1833	39.93
0.2000	38.40	0.2000	40.06
0.2166	38.58	0.2166	40.02
0.2333	38.64	0.2333	39.58
0.2500	38.71	0.2500	39.34
0.2666	38.67	0.2666	38.60
0.2833	38.59	0.2833	38.52
0.3000	38.48	0.3000	38.66
0.3166	38.37	0.3166	38.35
0.3333	38.28	0.3333	38.38
0.4167	38.21	0.4167	38.35
0.5000	38.24	0.5000	37.86
0.5833	38.32	0.5833	38.58
0.6667	38.38	0.6667	38.44
0.7500	38.44	0.7500	38.48
0.8333	38.50	0.8333	38.24
0.9167	38.55	0.9167	38.53
1.0000	38.60	1.0000	38.86
1.0833	38.64	1.0833	38.82
1.1667	38.68	1.1667	38.50
1.2500	38.72	1.2500	38.63
1.3333	38.76	1.3333	38.70
1.4166	38.79	1.4166	39.23
1.5000	38.81	1.5000	38.80
1.5833	38.84	1.5833	39.00
1.6667	38.87	1.6667	38.83
1.7500	38.89	1.7500	38.82
1.8333	38.92	1.8333	38.68
1.9167	38.94	1.9167	38.96
2.0000	38.96	2.0000	39.18
2.5000	39.07	2.5000	38.87
3.0000	39.15	3.0000	38.99
3.5000	39.21	3.5000	39.14
4.0000	39.25	4.0000	39.43
4.5000	39.30	4.5000	39.66
5.0000	39.29	5.0000	39.51
5.5000	39.37	5.5000	39.46

Elapsed Time	Value	Elapsed Time	Value
6.0000	39.43	6.0000	39.37
6.5000	39.44	6.5000	39.63
7.0000	39.47	7.0000	39.66
7.5000	39.49	7.5000	39.49
8.0000	39.51	8.0000	39.83
8.5000	39.53	8.5000	39.48
9.0000	39.55	9.0000	39.81
9.5000	39.56	9.5000	39.84
10.0000	39.58	10.0000	39.51
12.0000	39.63	12.0000	39.75
14.0000	39.68	14.0000	40.02
16.0000	39.72	16.0000	39.94
18.0000	39.75	18.0000	39.91
20.0000	39.78	20.0000	39.72
22.0000	39.82	22.0000	40.00
24.0000	39.84	24.0000	40.10
26.0000	39.86	26.0000	39.71
28.0000	39.87	28.0000	40.06
30.0000	39.89	30.0000	40.12
32.0000	39.92	32.0000	39.80
34.0000	39.87	34.0000	39.89
36.0000	39.94	36.0000	40.02
38.0000	39.96	38.0000	40.10
40.0000	39.98	40.0000	40.17
42.0000	40.00	42.0000	39.76
44.0000	40.01	44.0000	40.19
46.0000	40.01	46.0000	40.19
48.0000	40.03	48.0000	39.93
50.0000	40.04	50.0000	40.44
END		END	

SE1000B
Environmental Logger
09/24 08:55

SE1000B
Environmental Logger
09/24 08:45

Unit# 00222 Test# 1 Unit# 00222 Test# 1

INPUT 1: Level (F) TOC INPUT 2: Level (F) TOC

Reference	34.85	Reference	33.97
Scale factor	20.01	Scale factor	20.11
Offset	- 0.06	Offset	0.00

Step# 2 09/23 11:07 Step# 2 09/23 11:07

Elapsed Time	Value	Elapsed Time	Value
0.0000	40.06	0.0000	40.17
0.0033	40.06	0.0033	40.18
0.0066	40.06	0.0066	39.91
0.0099	40.06	0.0099	40.04
0.0133	40.06	0.0133	40.07
0.0166	40.06	0.0166	40.45
0.0200	40.06	0.0200	40.02
0.0233	40.06	0.0233	40.11
0.0266	40.06	0.0266	40.26
0.0300	40.06	0.0300	40.43
0.0333	40.06	0.0333	40.01
0.0500	40.06	0.0500	39.93
0.0666	40.06	0.0666	40.15
0.0833	40.06	0.0833	39.77
0.1000	40.06	0.1000	40.38
0.1166	40.06	0.1166	40.13
0.1333	40.06	0.1333	40.20
0.1500	40.06	0.1500	40.18
0.1666	40.06	0.1666	40.39
0.1833	40.06	0.1833	39.91
0.2000	40.06	0.2000	40.40
0.2166	40.06	0.2166	40.23
0.2333	40.06	0.2333	40.24
0.2500	40.06	0.2500	40.16
0.2666	40.06	0.2666	40.14
0.2833	40.06	0.2833	40.08
0.3000	40.06	0.3000	40.28
0.3166	40.06	0.3166	39.88
0.3333	40.06	0.3333	39.98
0.4167	40.06	0.4167	40.23
0.5000	40.06	0.5000	39.79
0.5833	40.06	0.5833	40.05

Elapsed Time	Value	Elapsed Time	Value
0.6667	40.06	0.6667	40.13
0.7500	39.32	0.7500	37.91
0.8333	38.36	0.8333	37.62
0.9167	38.09	0.9167	37.12
1.0000	37.84	1.0000	36.90
1.0833	37.66	1.0833	36.80
1.1667	37.53	1.1667	36.62
1.2500	37.42	1.2500	36.51
1.3333	37.33	1.3333	36.43
1.4166	37.25	1.4166	36.33
1.5000	37.18	1.5000	36.26
1.5833	37.11	1.5833	36.18
1.6667	37.06	1.6667	36.20
1.7500	37.01	1.7500	36.11
1.8333	36.96	1.8333	36.00
1.9167	36.91	1.9167	36.01
2.0000	36.87	2.0000	35.97
2.5000	36.68	2.5000	35.75
3.0000	36.53	3.0000	35.66
3.5000	36.44	3.5000	35.54
4.0000	36.37	4.0000	35.42
4.5000	38.69	4.5000	38.88
5.0000	39.10	5.0000	38.84
5.5000	39.36	5.5000	39.52
6.0000	39.49	6.0000	39.35
6.5000	39.57	6.5000	39.50
7.0000	39.65	7.0000	39.35
7.5000	39.68	7.5000	39.51
8.0000	39.73	8.0000	39.98
8.5000	39.77	8.5000	39.67
9.0000	39.79	9.0000	39.94
9.5000	39.82	9.5000	39.95
10.0000	39.84	10.0000	40.05
12.0000	39.90	12.0000	39.89
14.0000	39.96	14.0000	40.10
16.0000	42.88	16.0000	42.84
18.0000	52.39	18.0000	49.22
20.0000	45.60	20.0000	45.32
22.0000	45.24	22.0000	45.18
24.0000	45.38	24.0000	45.03
26.0000	45.74	26.0000	45.56
28.0000	45.67	28.0000	45.52
30.0000	45.65	30.0000	45.46
32.0000	41.42	32.0000	42.97
34.0000	39.82	34.0000	40.95
36.0000	47.98	36.0000	46.71

Elapsed Time	Value	Elapsed Time	Value
38.0000	50.60	38.0000	48.62
40.0000	49.01	40.0000	48.04
42.0000	49.26	42.0000	47.94
44.0000	49.14	44.0000	48.22
46.0000	49.19	46.0000	48.11
48.0000	49.28	48.0000	48.00
50.0000	49.28	50.0000	48.14
52.0000	49.22	52.0000	48.31
54.0000	42.45	54.0000	43.84
56.0000	40.58	56.0000	42.09
58.0000	40.60	58.0000	41.79
60.0000	47.83	60.0000	47.12
62.0000	48.45	62.0000	47.55
64.0000	48.35	64.0000	47.75
66.0000	48.70	66.0000	47.73
68.0000	48.55	68.0000	47.95
70.0000	48.81	70.0000	47.71
72.0000	48.73	72.0000	47.98
74.0000	48.69	74.0000	47.88
76.0000	40.93	76.0000	42.13
78.0000	40.78	78.0000	42.12

END

END

SE1000B
Environmental Logger
09/24 08:57

SE1000B
Environmental Logger
09/24 08:47

Unit# 00222 Test# 2

Unit# 00222 Test# 2

INPUT 1: Level (F) TOC INPUT 2: Level (F) TOC

Reference	34.85	Reference	33.97
Scale factor	20.01	Scale factor	20.11
Offset	- 0.06	Offset	0.00

Step# 0 09/23 12:31 Step# 0 09/23 12:31

Elapsed Time	Value	Elapsed Time	Value
0.0000	48.00	0.0000	47.32
0.0033	47.89	0.0033	47.34
0.0066	47.82	0.0066	47.12
0.0099	47.63	0.0099	47.39
0.0133	47.79	0.0133	47.19
0.0166	47.99	0.0166	47.40

Elapsed Time	Value	Elapsed Time	Value
0.0200	48.11	0.0200	47.37
0.0233	48.04	0.0233	47.35
0.0266	47.92	0.0266	47.24
0.0300	47.82	0.0300	47.44
0.0333	47.97	0.0333	47.16
0.0500	47.80	0.0500	47.32
0.0666	47.92	0.0666	47.27
0.0833	47.82	0.0833	47.38
0.1000	48.03	0.1000	47.34
0.1166	48.11	0.1166	47.52
0.1333	48.01	0.1333	47.25
0.1500	47.83	0.1500	47.11
0.1666	48.14	0.1666	47.32
0.1833	47.99	0.1833	47.41
0.2000	47.97	0.2000	47.31
0.2166	47.75	0.2166	47.04
0.2333	47.85	0.2333	47.31
0.2500	47.68	0.2500	47.41
0.2666	47.78	0.2666	47.22
0.2833	47.77	0.2833	47.32
0.3000	47.85	0.3000	47.43
0.3166	47.92	0.3166	47.53
0.3333	48.06	0.3333	47.27
0.4167	48.00	0.4167	47.28
0.5000	48.16	0.5000	47.30
0.5833	47.99	0.5833	47.28
0.6667	47.81	0.6667	47.24
0.7500	47.84	0.7500	47.42
0.8333	47.97	0.8333	47.38
0.9167	48.16	0.9167	47.35
1.0000	47.98	1.0000	47.42
1.0833	47.85	1.0833	47.33
1.1667	47.97	1.1667	47.27
1.2500	48.07	1.2500	47.24
1.3333	47.93	1.3333	47.46
1.4166	48.05	1.4166	47.29
1.5000	48.27	1.5000	47.41
1.5833	47.93	1.5833	47.52
1.6667	48.06	1.6667	47.48
1.7500	47.99	1.7500	47.24
1.8333	47.86	1.8333	47.48
1.9167	48.04	1.9167	47.32
2.0000	48.06	2.0000	47.40
2.5000	48.02	2.5000	47.47
3.0000	48.02	3.0000	47.62
3.5000	48.24	3.5000	47.22

Elapsed Time	Value	Elapsed Time	Value
4.0000	48.14	4.0000	47.58
4.5000	48.14	4.5000	47.43
5.0000	48.30	5.0000	47.57
5.5000	48.01	5.5000	47.57
6.0000	47.94	6.0000	47.62
6.5000	48.03	6.5000	47.21
7.0000	48.09	7.0000	47.76
7.5000	48.02	7.5000	47.53
8.0000	47.99	8.0000	47.57
8.5000	48.19	8.5000	47.44
9.0000	48.05	9.0000	47.51
9.5000	48.22	9.5000	47.55
10.0000	48.23	10.0000	47.48
12.0000	48.16	12.0000	47.60
14.0000	48.30	14.0000	47.47
16.0000	48.20	16.0000	47.64
18.0000	48.33	18.0000	47.63
20.0000	48.11	20.0000	47.76
22.0000	48.26	22.0000	47.72
24.0000	48.25	24.0000	47.84
26.0000	48.30	26.0000	47.71
28.0000	48.37	28.0000	47.69
30.0000	48.29	30.0000	47.86
32.0000	48.52	32.0000	47.78
34.0000	48.45	34.0000	47.86
36.0000	48.46	36.0000	47.92
38.0000	48.62	38.0000	48.11
40.0000	48.50	40.0000	47.87
42.0000	48.26	42.0000	47.97
44.0000	48.48	44.0000	47.92
46.0000	48.59	46.0000	47.90
48.0000	48.50	48.0000	47.58
50.0000	48.55	50.0000	47.93
52.0000	48.47	52.0000	47.87
54.0000	48.67	54.0000	47.98
56.0000	48.42	56.0000	48.04
58.0000	48.61	58.0000	47.90
60.0000	48.32	60.0000	48.11
62.0000	48.56	62.0000	47.76
64.0000	48.42	64.0000	47.69
66.0000	48.63	66.0000	48.07
68.0000	48.47	68.0000	48.07
70.0000	48.38	70.0000	48.04
72.0000	48.54	72.0000	48.01
74.0000	48.45	74.0000	47.69
76.0000	48.62	76.0000	47.95

Elapsed Time	Value	Elapsed Time	Value
78.0000	48.51	78.0000	48.07
80.0000	48.49	80.0000	47.92
82.0000	48.62	82.0000	47.81
84.0000	48.81	84.0000	47.98
86.0000	48.62	86.0000	47.88
88.0000	48.51	88.0000	47.92
90.0000	48.62	90.0000	48.10
92.0000	48.67	92.0000	48.06
94.0000	48.74	94.0000	47.98
96.0000	48.57	96.0000	47.86
98.0000	48.46	98.0000	47.72
100.0000	48.35	100.0000	47.85
110.0000	48.71	110.0000	47.86
120.0000	48.42	120.0000	47.76
130.0000	48.39	130.0000	47.82
140.0000	48.34	140.0000	47.86
150.0000	48.37	150.0000	47.86
160.0000	48.62	160.0000	48.02
170.0000	48.45	170.0000	47.95
180.0000	48.49	180.0000	47.78
190.0000	48.35	190.0000	47.85
200.0000	48.46	200.0000	47.89
210.0000	48.26	210.0000	47.98
220.0000	48.62	220.0000	47.98
230.0000	48.48	230.0000	48.05
240.0000	48.42	240.0000	47.89
250.0000	48.34	250.0000	48.11
260.0000	48.49	260.0000	47.80
270.0000	48.54	270.0000	48.00
280.0000	48.57	280.0000	47.94
290.0000	48.49	290.0000	48.11
300.0000	48.52	300.0000	48.05
310.0000	48.70	310.0000	47.93
320.0000	48.56	320.0000	47.83
330.0000	48.57	330.0000	48.13
340.0000	48.55	340.0000	48.30
350.0000	48.43	350.0000	47.91
360.0000	48.55	360.0000	48.04
370.0000	48.51	370.0000	48.14
380.0000	48.65	380.0000	48.00
390.0000	48.59	390.0000	48.30
400.0000	48.42	400.0000	47.95
410.0000	48.52	410.0000	47.72
420.0000	48.62	420.0000	47.88
430.0000	48.49	430.0000	48.03
440.0000	48.43	440.0000	47.94

Elapsed Time	Value	Elapsed Time	Value
450.000	48.55	450.000	47.87
460.000	48.54	460.000	47.84
470.000	48.57	470.000	47.97
480.000	48.56	480.000	47.95
490.000	48.63	490.000	47.89
500.000	48.53	500.000	48.12
510.000	48.47	510.000	48.12
520.000	48.69	520.000	48.01
530.000	48.59	530.000	48.01
540.000	48.55	540.000	48.14
550.000	48.63	550.000	48.06
560.000	48.65	560.000	48.01
570.000	48.57	570.000	48.02
580.000	48.59	580.000	47.90
590.000	48.69	590.000	48.01
600.000	48.54	600.000	48.07
610.000	48.61	610.000	47.88
620.000	48.69	620.000	47.93
630.000	48.60	630.000	47.81
640.000	48.52	640.000	47.93
650.000	48.45	650.000	48.22
660.000	48.60	660.000	48.25
670.000	48.67	670.000	48.16
680.000	48.49	680.000	48.08
690.000	48.41	690.000	47.94
700.000	48.76	700.000	47.93
710.000	48.72	710.000	47.83
720.000	48.59	720.000	48.12
730.000	48.54	730.000	47.79
740.000	48.62	740.000	47.72
750.000	48.43	750.000	48.14
760.000	48.52	760.000	47.90
770.000	48.51	770.000	48.22
780.000	48.58	780.000	47.85
790.000	48.62	790.000	48.16
800.000	48.53	800.000	47.94
810.000	48.61	810.000	47.82
820.000	48.35	820.000	48.09
830.000	48.59	830.000	48.01
840.000	48.55	840.000	48.13
850.000	48.51	850.000	47.73
860.000	48.61	860.000	47.91
870.000	48.57	870.000	47.84
880.000	48.51	880.000	48.09
890.000	48.59	890.000	48.09
900.000	48.49	900.000	48.09

Elapsed Time	Value	Elapsed Time	Value
910.000	48.48	910.000	47.84
920.000	48.54	920.000	47.97
930.000	48.56	930.000	47.84
940.000	48.53	940.000	48.04
950.000	48.50	950.000	47.90
960.000	48.42	960.000	47.95
970.000	48.66	970.000	48.09
980.000	48.52	980.000	48.06
990.000	48.54	990.000	48.00
1000.00	48.57	1000.00	48.11
1015.00	48.62	1015.00	47.88
1030.00	48.53	1030.00	47.61
1045.00	48.50	1045.00	48.04
1060.00	48.43	1060.00	47.78
1075.00	48.51	1075.00	47.94
1090.00	48.53	1090.00	47.88
1105.00	48.47	1105.00	48.06
1120.00	48.55	1120.00	47.97
1135.00	48.67	1135.00	48.07
1150.00	48.54	1150.00	48.08
1165.00	48.66	1165.00	48.08
1180.00	48.52	1180.00	48.18
1195.00	48.08	1195.00	47.91
1210.00	48.14	1210.00	47.57
1225.00	48.11	END	

END

SE1000B	SE1000B
Environmental Logger	Environmental Logger
10/01 07:41	10/01 08:03

Unit# 00222 Test# 2 Unit# 00222 Test# 2

INPUT 1: Level (F) TOC INPUT 2: Level (F) TOC

Reference	34.85	Reference	33.97
Scale factor	20.01	Scale factor	20.11
Offset	- 0.06	Offset	0.00

Step# 0 09/23 12:31 Step# 0 09/23 12:31

Elapsed Time	Value	Elapsed Time	Value
0.0000	48.00	0.0000	47.32
0.0033	47.89	0.0033	47.34

Elapsed Time	Value	Elapsed Time	Value
0.0066	47.82	0.0066	47.12
0.0099	47.63	0.0099	47.39
0.0133	47.79	0.0133	47.19
0.0166	47.99	0.0166	47.40
0.0200	48.11	0.0200	47.37
0.0233	48.04	0.0233	47.35
0.0266	47.92	0.0266	47.24
0.0300	47.82	0.0300	47.44
0.0333	47.97	0.0333	47.16
0.0500	47.80	0.0500	47.32
0.0666	47.92	0.0666	47.27
0.0833	47.82	0.0833	47.38
0.1000	48.03	0.1000	47.34
0.1166	48.11	0.1166	47.52
0.1333	48.01	0.1333	47.25
0.1500	47.83	0.1500	47.11
0.1666	48.14	0.1666	47.32
0.1833	47.99	0.1833	47.41
0.2000	47.97	0.2000	47.31
0.2166	47.75	0.2166	47.04
0.2333	47.85	0.2333	47.31
0.2500	47.68	0.2500	47.41
0.2666	47.78	0.2666	47.22
0.2833	47.77	0.2833	47.32
0.3000	47.85	0.3000	47.43
0.3166	47.92	0.3166	47.53
0.3333	48.06	0.3333	47.27
0.4167	48.00	0.4167	47.28
0.5000	48.16	0.5000	47.30
0.5833	47.99	0.5833	47.28
0.6667	47.81	0.6667	47.24
0.7500	47.84	0.7500	47.42
0.8333	47.97	0.8333	47.38
0.9167	48.16	0.9167	47.35
1.0000	47.98	1.0000	47.42
1.0833	47.85	1.0833	47.33
1.1667	47.97	1.1667	47.27
1.2500	48.07	1.2500	47.24
1.3333	47.93	1.3333	47.46
1.4166	48.05	1.4166	47.29
1.5000	48.27	1.5000	47.41
1.5833	47.93	1.5833	47.52
1.6667	48.06	1.6667	47.48
1.7500	47.99	1.7500	47.24
1.8333	47.86	1.8333	47.48
1.9167	48.04	1.9167	47.32

Elapsed Time	Value	Elapsed Time	Value
2.0000	48.06	2.0000	47.40
2.5000	48.02	2.5000	47.47
3.0000	48.02	3.0000	47.62
3.5000	48.24	3.5000	47.22
4.0000	48.14	4.0000	47.58
4.5000	48.14	4.5000	47.43
5.0000	48.30	5.0000	47.57
5.5000	48.01	5.5000	47.57
6.0000	47.94	6.0000	47.62
6.5000	48.03	6.5000	47.21
7.0000	48.09	7.0000	47.76
7.5000	48.02	7.5000	47.53
8.0000	47.99	8.0000	47.57
8.5000	48.19	8.5000	47.44
9.0000	48.05	9.0000	47.51
9.5000	48.22	9.5000	47.55
10.0000	48.23	10.0000	47.48
12.0000	48.16	12.0000	47.60
14.0000	48.30	14.0000	47.47
16.0000	48.20	16.0000	47.64
18.0000	48.33	18.0000	47.63
20.0000	48.11	20.0000	47.76
22.0000	48.26	22.0000	47.72
24.0000	48.25	24.0000	47.84
26.0000	48.30	26.0000	47.71
28.0000	48.37	28.0000	47.69
30.0000	48.29	30.0000	47.86
32.0000	48.52	32.0000	47.78
34.0000	48.45	34.0000	47.86
36.0000	48.46	36.0000	47.92
38.0000	48.62	38.0000	48.11
40.0000	48.50	40.0000	47.87
42.0000	48.26	42.0000	47.97
44.0000	48.48	44.0000	47.92
46.0000	48.59	46.0000	47.90
48.0000	48.50	48.0000	47.58
50.0000	48.55	50.0000	47.93
52.0000	48.47	52.0000	47.87
54.0000	48.67	54.0000	47.98
56.0000	48.42	56.0000	48.04
58.0000	48.61	58.0000	47.90
60.0000	48.32	60.0000	48.11
62.0000	48.56	62.0000	47.76
64.0000	48.42	64.0000	47.69
66.0000	48.63	66.0000	48.07
68.0000	48.47	68.0000	48.07

Elapsed Time	Value	Elapsed Time	Value
70.0000	48.38	70.0000	48.04
72.0000	48.54	72.0000	48.01
74.0000	48.45	74.0000	47.69
76.0000	48.62	76.0000	47.95
78.0000	48.51	78.0000	48.07
80.0000	48.49	80.0000	47.92
82.0000	48.62	82.0000	47.81
84.0000	48.81	84.0000	47.98
86.0000	48.62	86.0000	47.88
88.0000	48.51	88.0000	47.92
90.0000	48.62	90.0000	48.10
92.0000	48.67	92.0000	48.06
94.0000	48.74	94.0000	47.98
96.0000	48.57	96.0000	47.86
98.0000	48.46	98.0000	47.72
100.0000	48.35	100.0000	47.85
110.0000	48.71	110.0000	47.86
120.0000	48.42	120.0000	47.76
130.0000	48.39	130.0000	47.82
140.0000	48.34	140.0000	47.86
150.0000	48.37	150.0000	47.86
160.0000	48.62	160.0000	48.02
170.0000	48.45	170.0000	47.95
180.0000	48.49	180.0000	47.78
190.0000	48.35	190.0000	47.85
200.0000	48.46	200.0000	47.89
210.0000	48.26	210.0000	47.98
220.0000	48.62	220.0000	47.98
230.0000	48.48	230.0000	48.05
240.0000	48.42	240.0000	47.89
250.0000	48.34	250.0000	48.11
260.0000	48.49	260.0000	47.80
270.0000	48.54	270.0000	48.00
280.0000	48.57	280.0000	47.94
290.0000	48.49	290.0000	48.11
300.0000	48.52	300.0000	48.05
310.0000	48.70	310.0000	47.93
320.0000	48.56	320.0000	47.83
330.0000	48.57	330.0000	48.13
340.0000	48.55	340.0000	48.30
350.0000	48.43	350.0000	47.91
360.0000	48.55	360.0000	48.04
370.0000	48.51	370.0000	48.14
380.0000	48.65	380.0000	48.00
390.0000	48.59	390.0000	48.30
400.0000	48.42	400.0000	47.95

Elapsed Time	Value	Elapsed Time	Value
410.000	48.52	410.000	47.72
420.000	48.62	420.000	47.88
430.000	48.49	430.000	48.03
440.000	48.43	440.000	47.94
450.000	48.55	450.000	47.87
460.000	48.54	460.000	47.84
470.000	48.57	470.000	47.97
480.000	48.56	480.000	47.95
490.000	48.63	490.000	47.89
500.000	48.53	500.000	48.12
510.000	48.47	510.000	48.12
520.000	48.69	520.000	48.01
530.000	48.59	530.000	48.01
540.000	48.55	540.000	48.14
550.000	48.63	550.000	48.06
560.000	48.65	560.000	48.01
570.000	48.57	570.000	48.02
580.000	48.59	580.000	47.90
590.000	48.69	590.000	48.01
600.000	48.54	600.000	48.07
610.000	48.61	610.000	47.88
620.000	48.69	620.000	47.93
630.000	48.60	630.000	47.81
640.000	48.52	640.000	47.93
650.000	48.45	650.000	48.22
660.000	48.60	660.000	48.25
670.000	48.67	670.000	48.16
680.000	48.49	680.000	48.08
690.000	48.41	690.000	47.94
700.000	48.76	700.000	47.93
710.000	48.72	710.000	47.83
720.000	48.59	720.000	48.12
730.000	48.54	730.000	47.79
740.000	48.62	740.000	47.72
750.000	48.43	750.000	48.14
760.000	48.52	760.000	47.90
770.000	48.51	770.000	48.22
780.000	48.58	780.000	47.85
790.000	48.62	790.000	48.16
800.000	48.53	800.000	47.94
810.000	48.61	810.000	47.82
820.000	48.35	820.000	48.09
830.000	48.59	830.000	48.01
840.000	48.55	840.000	48.13
850.000	48.51	850.000	47.73
860.000	48.61	860.000	47.91

Elapsed Time	Value	Elapsed Time	Value
870.000	48.57	870.000	47.84
880.000	48.51	880.000	48.09
890.000	48.59	890.000	48.09
900.000	48.49	900.000	48.09
910.000	48.48	910.000	47.84
920.000	48.54	920.000	47.97
930.000	48.56	930.000	47.84
940.000	48.53	940.000	48.04
950.000	48.50	950.000	47.90
960.000	48.42	960.000	47.95
970.000	48.66	970.000	48.09
980.000	48.52	980.000	48.06
990.000	48.54	990.000	48.00
1000.00	48.57	1000.00	48.11
1015.00	48.62	1015.00	47.88
1030.00	48.53	1030.00	47.61
1045.00	48.50	1045.00	48.04
1060.00	48.43	1060.00	47.78
1075.00	48.51	1075.00	47.94
1090.00	48.53	1090.00	47.88
1105.00	48.47	1105.00	48.06
1120.00	48.55	1120.00	47.97
1135.00	48.67	1135.00	48.07
1150.00	48.54	1150.00	48.08
1165.00	48.66	1165.00	48.08
1180.00	48.52	1180.00	48.18
1195.00	48.08	1195.00	47.91
1210.00	48.14	1210.00	47.57
1225.00	48.11	1225.00	47.73
1240.00	48.06	1240.00	47.45
1255.00	48.01	1255.00	47.62
1270.00	48.02	1270.00	47.72
1285.00	48.07	1285.00	47.84
1300.00	48.02	1300.00	47.73
1315.00	48.01	1315.00	47.52
1330.00	47.93	1330.00	47.59
1345.00	48.07	1345.00	47.76
1360.00	47.93	1360.00	47.60
1375.00	48.07	1375.00	47.71
1390.00	47.95	1390.00	47.77
1405.00	47.95	1405.00	47.60
1420.00	47.89	1420.00	47.53
1435.00	47.91	1435.00	47.40
1450.00	48.07	1450.00	47.40
1465.00	48.07	1465.00	47.62
1480.00	47.82	1480.00	47.50

Elapsed Time	Value	Elapsed Time	Value
1495.00	47.90	1495.00	47.77
1510.00	48.04	1510.00	47.39
1525.00	47.97	1525.00	47.62
1540.00	47.88	1540.00	47.67
1555.00	47.96	1555.00	47.50
1570.00	47.87	1570.00	47.66
1585.00	48.02	1585.00	47.45
1600.00	48.04	1600.00	47.38
1615.00	48.04	1615.00	47.65
1630.00	48.00	1630.00	47.69
1645.00	48.04	1645.00	47.63
1660.00	48.04	1660.00	47.76
1675.00	48.00	1675.00	47.52
1690.00	47.90	1690.00	47.66
1705.00	48.09	1705.00	47.46
1720.00	47.89	1720.00	47.64
1735.00	47.97	1735.00	47.44
1750.00	47.85	1750.00	47.53
1765.00	47.99	1765.00	47.55
1780.00	47.97	1780.00	47.58
1795.00	48.04	1795.00	47.71
1810.00	48.65	1810.00	47.87
1825.00	48.78	1825.00	48.02
1840.00	48.97	1840.00	48.04
1855.00	48.90	1855.00	48.32
1870.00	48.83	1870.00	48.19
1885.00	48.68	1885.00	48.11
1900.00	48.91	1900.00	48.12
1915.00	48.75	1915.00	48.24
1930.00	48.90	1930.00	48.39
1945.00	48.76	1945.00	48.12
1960.00	49.01	1960.00	48.16
1975.00	48.91	1975.00	48.19
1990.00	48.95	1990.00	48.43
2005.00	48.89	2005.00	48.32
2020.00	48.95	2020.00	48.28
2035.00	48.84	2035.00	48.14
2050.00	48.85	2050.00	48.27
2065.00	48.93	2065.00	48.48
2080.00	48.81	2080.00	48.45
2095.00	48.85	2095.00	48.23
2110.00	48.76	2110.00	48.15
2125.00	48.90	2125.00	48.40
2140.00	48.81	2140.00	48.32
2155.00	48.87	2155.00	48.30
2170.00	48.77	2170.00	48.31

Elapsed Time	Value	Elapsed Time	Value
2185.00	48.86	2185.00	48.21
2200.00	48.84	2200.00	48.22
2215.00	48.90	2215.00	48.24
2230.00	48.85	2230.00	48.30
2245.00	48.97	2245.00	48.20
2260.00	48.91	2260.00	48.33
2275.00	48.69	2275.00	48.14
2290.00	48.76	2290.00	48.18
2305.00	48.91	2305.00	48.04
2320.00	48.94	2320.00	48.43
2335.00	48.88	2335.00	48.36
2350.00	48.95	2350.00	48.31
2365.00	48.90	2365.00	48.23
2380.00	48.86	2380.00	48.45
2395.00	48.64	2395.00	48.25
2410.00	48.72	2410.00	48.29
2425.00	48.80	2425.00	47.98
2440.00	48.85	2440.00	48.07
2455.00	48.69	2455.00	48.26
2470.00	48.86	2470.00	48.34
2485.00	48.88	2485.00	48.02
2500.00	48.90	2500.00	48.28
2515.00	48.66	2515.00	48.07
2530.00	48.79	2530.00	48.26
2545.00	48.83	2545.00	48.14
2560.00	48.95	2560.00	48.33
2575.00	49.00	2575.00	48.17
2590.00	48.94	2590.00	48.31
2605.00	48.91	2605.00	48.46
2620.00	48.90	2620.00	48.31
2635.00	49.06	2635.00	48.12
2650.00	48.98	2650.00	48.16
2665.00	49.09	2665.00	48.35
2680.00	48.98	2680.00	48.42
2695.00	48.98	2695.00	48.35
2710.00	48.99	2710.00	48.37
2725.00	49.00	2725.00	48.33
2740.00	49.12	2740.00	48.52
2755.00	49.12	2755.00	48.42
2770.00	49.12	2770.00	48.48
2785.00	49.18	2785.00	48.23
2800.00	49.07	2800.00	48.61
2815.00	49.00	2815.00	48.55
2830.00	49.05	2830.00	48.30
2845.00	49.10	2845.00	48.51
2860.00	49.19	2860.00	48.43

Elapsed Time	Value	Elapsed Time	Value
2875.00	48.98	2875.00	48.33
2890.00	49.01	2890.00	48.54
2905.00	49.03	2905.00	48.45
2920.00	48.97	2920.00	48.52
2935.00	49.00	2935.00	48.62
2950.00	49.02	2950.00	48.44
2965.00	49.02	2965.00	48.64
2980.00	48.91	2980.00	48.56
2995.00	48.86	2995.00	48.12
3010.00	49.04	3010.00	48.53
3025.00	49.00	3025.00	48.47
3040.00	49.08	3040.00	48.37
3055.00	49.04	3055.00	48.54
3070.00	48.91	3070.00	48.39
3085.00	48.93	3085.00	48.22
3100.00	49.12	3100.00	48.32
3115.00	48.95	3115.00	48.30
3130.00	48.89	3130.00	48.30
3145.00	49.06	3145.00	48.33
3160.00	48.94	3160.00	48.29
3175.00	48.89	3175.00	48.23
3190.00	48.62	3190.00	47.96
3205.00	48.59	3205.00	47.78
3220.00	48.65	3220.00	47.91
3235.00	48.62	3235.00	48.02
3250.00	48.49	3250.00	47.84
3265.00	48.49	3265.00	47.81
3280.00	48.45	3280.00	47.71
3295.00	48.59	3295.00	48.05
3310.00	48.32	3310.00	48.06
3325.00	48.46	3325.00	47.94
3340.00	48.52	3340.00	47.87
3355.00	48.49	3355.00	47.88
3370.00	48.40	3370.00	47.82
3385.00	48.49	3385.00	47.88
3400.00	48.47	3400.00	47.75
3415.00	48.42	3415.00	47.74
3430.00	48.55	3430.00	47.85
3445.00	48.57	3445.00	48.17
3460.00	48.50	3460.00	47.86
3475.00	48.41	3475.00	48.04
3490.00	48.37	3490.00	47.84
3505.00	48.26	3505.00	47.87
3520.00	48.43	3520.00	47.98
3535.00	48.37	3535.00	47.62
3550.00	48.26	3550.00	47.89

Elapsed Time	Value	Elapsed Time	Value
3565.00	48.24	3565.00	47.78
3580.00	48.26	3580.00	47.57
3595.00	48.37	3595.00	47.89
3610.00	48.31	3610.00	47.85
3625.00	48.23	3625.00	47.65
3640.00	48.33	3640.00	47.68
3655.00	48.30	3655.00	47.77
3670.00	48.41	3670.00	47.91
3685.00	48.33	3685.00	47.65
3700.00	48.38	3700.00	47.91
3715.00	48.20	3715.00	47.84
3730.00	48.22	3730.00	47.77
3745.00	48.34	3745.00	47.81
3760.00	48.36	3760.00	47.79
3775.00	48.23	3775.00	47.79
3790.00	48.27	3790.00	48.03
3805.00	48.39	3805.00	47.78
3820.00	48.30	3820.00	47.64
3835.00	48.20	3835.00	48.00
3850.00	48.40	3850.00	47.84
3865.00	48.21	3865.00	47.90
3880.00	48.31	3880.00	47.83
3895.00	48.36	3895.00	47.53
3910.00	48.35	3910.00	47.81
3925.00	48.17	3925.00	47.82
3940.00	48.37	3940.00	47.97
3955.00	48.41	3955.00	47.75
3970.00	48.21	3970.00	47.91
3985.00	48.30	3985.00	47.68
4000.00	48.37	4000.00	47.74
4015.00	48.25	4015.00	47.90
4030.00	48.33	4030.00	47.71
4045.00	48.35	4045.00	47.88
4060.00	48.34	4060.00	47.57
4075.00	48.31	4075.00	47.79
4090.00	48.41	4090.00	47.72
4105.00	48.29	4105.00	47.70
4120.00	48.37	4120.00	47.71
4135.00	48.25	4135.00	47.69
4150.00	48.16	4150.00	47.66
4165.00	48.25	4165.00	47.79
4180.00	48.23	4180.00	47.82
4195.00	48.34	4195.00	47.55
4210.00	48.14	4210.00	47.91
4225.00	48.25	4225.00	47.87
4240.00	48.26	4240.00	47.83

Elapsed Time	Value	Elapsed Time	Value
4255.00	48.62	4255.00	48.13
4270.00	48.66	4270.00	48.19
4285.00	48.66	4285.00	48.10
4300.00	48.66	4300.00	47.95
4315.00	48.69	4315.00	48.20
4330.00	48.61	4330.00	47.80
4345.00	48.69	4345.00	48.06
4360.00	48.66	4360.00	48.02
4375.00	48.61	4375.00	48.04
4390.00	48.73	4390.00	48.05
4405.00	48.64	4405.00	47.95
4420.00	48.60	4420.00	48.00
4435.00	48.61	4435.00	48.26
4450.00	48.69	4450.00	47.90
4465.00	48.68	4465.00	48.03
4480.00	48.56	4480.00	48.06
4495.00	48.61	4495.00	48.09
4510.00	48.65	4510.00	48.03
4525.00	48.79	4525.00	48.07
4540.00	48.53	4540.00	48.00
4555.00	48.64	4555.00	47.86
4570.00	48.68	4570.00	47.84
4585.00	48.61	4585.00	47.71
4600.00	48.59	4600.00	47.84
4615.00	48.63	4615.00	48.04
4630.00	48.49	4630.00	47.86
4645.00	48.57	4645.00	47.68
4660.00	48.57	4660.00	47.98
4675.00	48.53	4675.00	48.19
4690.00	48.76	4690.00	47.93
4705.00	48.75	4705.00	47.86
4720.00	48.66	4720.00	47.78
4735.00	48.57	4735.00	48.02
4750.00	48.59	4750.00	47.99
4765.00	48.58	4765.00	48.10
4780.00	48.55	4780.00	48.07
4795.00	48.57	4795.00	47.81
4810.00	48.61	4810.00	47.90
4825.00	48.76	4825.00	47.88
4840.00	48.67	4840.00	47.92
4855.00	48.71	4855.00	48.02
4870.00	48.69	4870.00	48.00
4885.00	48.43	4885.00	48.17
4900.00	48.79	4900.00	47.96
4915.00	48.74	4915.00	48.06
4930.00	48.64	4930.00	47.97

Elapsed Time	Value	Elapsed Time	Value
4945.00	48.71	4945.00	48.10
4960.00	48.61	4960.00	48.03
4975.00	48.55	4975.00	47.97
4990.00	48.61	4990.00	48.14
5005.00	48.64	5005.00	47.91
5020.00	48.61	5020.00	47.99
5035.00	48.68	5035.00	48.02
5050.00	48.61	5050.00	48.09
5065.00	48.56	5065.00	47.74
5080.00	48.58	5080.00	47.88
5095.00	48.67	5095.00	47.90
5110.00	48.64	5110.00	48.14
5125.00	48.67	5125.00	47.95
5140.00	48.61	5140.00	48.00
5155.00	48.72	5155.00	47.89
5170.00	48.55	5170.00	48.00
5185.00	48.66	5185.00	47.91
5200.00	48.62	5200.00	48.23
5215.00	48.55	5215.00	48.01
5230.00	48.73	5230.00	47.90
5245.00	48.66	5245.00	47.90
5260.00	48.66	5260.00	48.06
5275.00	48.69	5275.00	48.08
5290.00	48.55	5290.00	48.12
5305.00	48.45	5305.00	48.00
5320.00	48.37	5320.00	47.88
5335.00	48.54	5335.00	48.29
5350.00	48.64	5350.00	48.23
5365.00	48.58	5365.00	47.91
5380.00	48.72	5380.00	47.90
5395.00	48.72	5395.00	47.95
5410.00	48.79	5410.00	48.05
5425.00	48.62	5425.00	47.99
5440.00	48.62	5440.00	47.95
5455.00	48.69	5455.00	48.07
5470.00	48.68	5470.00	48.14
5485.00	48.49	5485.00	48.10
5500.00	48.59	5500.00	47.93
5515.00	48.44	5515.00	48.02
5530.00	48.50	5530.00	47.80
5545.00	48.62	5545.00	47.85
5560.00	48.40	5560.00	48.02
5575.00	48.54	5575.00	47.88
5590.00	48.67	5590.00	48.11
5605.00	48.51	5605.00	47.98
5620.00	48.59	5620.00	48.09

Elapsed Time	Value	Elapsed Time	Value
5635.00	48.61	5635.00	47.78
5650.00	48.08	5650.00	47.75
5665.00	48.24	5665.00	47.72
5680.00	48.15	5680.00	47.75
5695.00	48.07	5695.00	47.69
5710.00	48.06	5710.00	47.58
5725.00	48.10	5725.00	47.59
5740.00	47.95	5740.00	47.50
5755.00	48.13	5755.00	47.48
5770.00	48.09	5770.00	47.63
5785.00	48.07	5785.00	47.51
5800.00	48.07	5800.00	47.46
5815.00	48.06	5815.00	47.44
5830.00	48.15	5830.00	47.67
5845.00	47.92	5845.00	47.49
5860.00	47.89	5860.00	47.34
5875.00	47.99	5875.00	47.27
5890.00	48.04	5890.00	47.53
5905.00	47.86	5905.00	47.52
5920.00	47.95	5920.00	47.42
5935.00	48.02	5935.00	47.55
5950.00	48.06	5950.00	47.55
5965.00	48.03	5965.00	47.46
5980.00	47.92	5980.00	47.56
5995.00	48.01	5995.00	47.58
6010.00	48.01	6010.00	47.47
6025.00	47.91	6025.00	47.31
6040.00	47.86	6040.00	47.52
6055.00	47.94	6055.00	47.55
6070.00	47.81	6070.00	47.46
6085.00	48.16	6085.00	47.67
6100.00	47.90	6100.00	47.48
6115.00	47.80	6115.00	47.48
6130.00	48.01	6130.00	47.40
6145.00	47.82	6145.00	47.21
6160.00	48.04	6160.00	47.58
6175.00	47.92	6175.00	47.50
6190.00	47.90	6190.00	47.43
6205.00	48.01	6205.00	47.68
6220.00	47.92	6220.00	47.48
6235.00	48.08	6235.00	47.38
6250.00	48.03	6250.00	47.57
6265.00	48.05	6265.00	47.70
6280.00	47.99	6280.00	47.32
6295.00	47.82	6295.00	47.45
6310.00	48.16	6310.00	47.41

Elapsed Time	Value	Elapsed Time	Value
6325.00	47.94	6325.00	47.76
6340.00	48.00	6340.00	47.52
6355.00	48.14	6355.00	47.65
6370.00	48.04	6370.00	47.58
6385.00	48.04	6385.00	47.53
6400.00	48.20	6400.00	47.55
6415.00	47.93	6415.00	47.63
6430.00	48.09	6430.00	47.63
6445.00	48.16	6445.00	47.61
6460.00	47.97	6460.00	47.80
6475.00	48.16	6475.00	47.65
6490.00	48.09	6490.00	47.78
6505.00	48.07	6505.00	47.71
6520.00	48.04	6520.00	47.58
6535.00	48.19	6535.00	47.81
6550.00	48.04	6550.00	47.24
6565.00	48.09	6565.00	47.40
6580.00	48.28	6580.00	47.64
6595.00	48.16	6595.00	47.65
6610.00	48.04	6610.00	47.69
6625.00	48.06	6625.00	47.53
6640.00	48.04	6640.00	47.33
6655.00	48.23	6655.00	47.64
6670.00	48.19	6670.00	47.83
6685.00	48.06	6685.00	47.58
6700.00	48.13	6700.00	47.55
6715.00	48.07	6715.00	47.41
6730.00	48.19	6730.00	47.69
6745.00	48.18	6745.00	47.50
6760.00	48.11	6760.00	47.44
6775.00	48.09	6775.00	47.77
6790.00	48.10	6790.00	47.67
6805.00	47.88	6805.00	47.51
6820.00	48.15	6820.00	47.54
6835.00	48.14	6835.00	47.62
6850.00	48.11	6850.00	47.55
6865.00	48.26	6865.00	47.60
6880.00	48.13	6880.00	47.86
6895.00	48.31	6895.00	47.98
6910.00	48.29	6910.00	47.50
6925.00	48.22	6925.00	47.72
6940.00	48.21	6940.00	47.77
6955.00	48.48	6955.00	47.69
6970.00	48.36	6970.00	47.69
6985.00	48.28	6985.00	47.69
7000.00	48.24	7000.00	47.96

Elapsed Time	Value	Elapsed Time	Value
7015.00	48.44	7015.00	47.73
7030.00	48.27	7030.00	47.84
7045.00	48.30	7045.00	47.90
7060.00	48.45	7060.00	47.79
7075.00	48.26	7075.00	47.93
7090.00	48.37	7090.00	47.75
7105.00	48.26	7105.00	47.83
7120.00	48.33	7120.00	47.90
7135.00	48.36	7135.00	47.85
7150.00	48.39	7150.00	47.91
7165.00	48.56	7165.00	48.06
7180.00	48.29	7180.00	47.85
7195.00	48.45	7195.00	47.70
7210.00	48.38	7210.00	47.67
7225.00	48.32	7225.00	47.94
7240.00	48.31	7240.00	47.90
7255.00	48.33	7255.00	47.82
7270.00	48.40	7270.00	47.73
7285.00	48.38	7285.00	47.78
7300.00	48.33	7300.00	47.73
7315.00	48.42	7315.00	47.65
7330.00	48.43	7330.00	47.69
7345.00	48.46	7345.00	47.68
7360.00	48.38	7360.00	48.04
7375.00	48.36	7375.00	47.69
7390.00	48.38	7390.00	47.81
7405.00	48.43	7405.00	48.00
7420.00	48.38	7420.00	47.79
7435.00	48.27	7435.00	47.67
7450.00	48.39	7450.00	47.91
7465.00	48.31	7465.00	47.99
7480.00	48.55	7480.00	47.79
7495.00	48.29	7495.00	47.90
7510.00	48.25	7510.00	47.90
7525.00	48.33	7525.00	47.70
7540.00	48.28	7540.00	47.88
7555.00	48.23	7555.00	47.71
7570.00	48.19	7570.00	47.76
7585.00	48.37	7585.00	47.75
7600.00	48.24	7600.00	47.75
7615.00	48.31	7615.00	47.62
7630.00	48.25	7630.00	47.60
7645.00	48.23	7645.00	47.58
7660.00	48.23	7660.00	47.53
7675.00	48.31	7675.00	47.68
7690.00	48.21	7690.00	47.86

Elapsed Time	Value	Elapsed Time	Value
7705.00	48.13	7705.00	47.70
7720.00	48.23	7720.00	47.59
7735.00	48.44	7735.00	47.69
7750.00	48.17	7750.00	47.69
7765.00	48.10	7765.00	47.64
7780.00	48.23	7780.00	47.68
7795.00	48.13	7795.00	47.78
7810.00	48.31	7810.00	47.74
7825.00	48.19	7825.00	47.62
7840.00	48.14	7840.00	47.64
7855.00	48.27	7855.00	47.61
7870.00	48.33	7870.00	47.81
7885.00	48.23	7885.00	47.58
7900.00	48.19	7900.00	47.73
7915.00	48.16	7915.00	47.79
7930.00	48.19	7930.00	47.68
7945.00	48.08	7945.00	47.56
7960.00	48.04	7960.00	47.58
7975.00	48.39	7975.00	47.86
7990.00	48.17	7990.00	47.62
8005.00	48.27	8005.00	47.60
8020.00	48.17	8020.00	47.74
8035.00	48.26	8035.00	47.57
8050.00	48.18	8050.00	47.44
8065.00	47.92	8065.00	47.64
8080.00	48.21	8080.00	47.46
8095.00	48.07	8095.00	47.62
8110.00	48.11	8110.00	47.74
8125.00	48.08	8125.00	47.55
8140.00	48.11	8140.00	47.60
8155.00	48.07	8155.00	47.74
8170.00	48.10	8170.00	47.73
8185.00	48.03	8185.00	47.78
8200.00	47.99	8200.00	47.71
8215.00	48.09	8215.00	47.51
8230.00	48.10	8230.00	47.46
8245.00	48.09	8245.00	47.69
8260.00	48.08	8260.00	47.67
8275.00	48.19	8275.00	47.59
8290.00	48.16	8290.00	47.60
8305.00	48.14	8305.00	47.76
8320.00	48.24	8320.00	47.81
8335.00	48.20	8335.00	47.68
8350.00	48.08	8350.00	47.59
8365.00	48.21	8365.00	47.61
8380.00	48.35	8380.00	47.90

Elapsed Time	Value	Elapsed Time	Value
8395.00	48.26	8395.00	47.75
8410.00	48.29	8410.00	47.82
8425.00	48.38	8425.00	47.83
8440.00	48.33	8440.00	47.71
8455.00	48.33	8455.00	47.83
8470.00	48.31	8470.00	47.91
8485.00	48.25	8485.00	47.69
8500.00	48.32	8500.00	47.66
8515.00	48.27	8515.00	47.79
8530.00	48.40	8530.00	47.71
8545.00	48.35	8545.00	47.78
8560.00	48.40	8560.00	47.81
8575.00	48.32	8575.00	47.90
8590.00	48.47	8590.00	47.76
8605.00	48.32	8605.00	47.70
8620.00	48.46	8620.00	47.84
8635.00	48.36	8635.00	47.96
8650.00	48.38	8650.00	47.90
8665.00	48.35	8665.00	47.95
8680.00	48.39	8680.00	47.88
8695.00	48.33	8695.00	48.05
8710.00	48.46	8710.00	47.95
8725.00	48.57	8725.00	47.89
8740.00	48.37	8740.00	47.88
8755.00	48.47	8755.00	47.75
8770.00	48.42	8770.00	47.82
8785.00	48.45	8785.00	47.78
8800.00	48.32	8800.00	47.76
8815.00	48.35	8815.00	47.85
8830.00	48.33	8830.00	47.88
8845.00	48.57	8845.00	47.87
8860.00	48.42	8860.00	48.00
8875.00	48.23	8875.00	47.81
8890.00	48.32	8890.00	47.92
8905.00	48.56	8905.00	48.03
8920.00	48.41	8920.00	47.64
8935.00	48.37	8935.00	47.83
8950.00	48.52	8950.00	47.64
8965.00	48.24	8965.00	47.69
8980.00	48.35	8980.00	47.79
8995.00	48.19	8995.00	47.77
9010.00	48.19	9010.00	47.71
9025.00	48.16	9025.00	47.71
9040.00	48.22	9040.00	47.45
9055.00	48.21	9055.00	47.76
9070.00	48.26	9070.00	47.58

Elapsed Time	Value	Elapsed Time	Value
9085.00	48.12	9085.00	47.58
9100.00	48.03	9100.00	47.65
9115.00	48.32	9115.00	47.54
9130.00	48.39	9130.00	47.73
9145.00	48.13	9145.00	47.67
9160.00	48.04	9160.00	47.71
9175.00	48.20	9175.00	47.76
9190.00	48.13	9190.00	47.55
9205.00	48.15	9205.00	47.65
9220.00	47.99	9220.00	47.57
9235.00	48.23	9235.00	47.78
9250.00	48.13	9250.00	47.53
9265.00	48.18	9265.00	47.74
9280.00	48.13	9280.00	47.48
9295.00	47.97	9295.00	47.72
9310.00	48.09	9310.00	47.60
9325.00	48.11	9325.00	47.60
9340.00	48.19	9340.00	47.76
9355.00	47.96	9355.00	47.42
9370.00	48.10	9370.00	47.48
9385.00	48.28	9385.00	47.72
9400.00	48.16	9400.00	47.51
9415.00	48.14	9415.00	47.69
9430.00	48.09	9430.00	47.60
9445.00	48.25	9445.00	47.49
9460.00	48.10	9460.00	47.72
9475.00	47.97	9475.00	47.63
9490.00	48.00	9490.00	47.69
9505.00	48.12	9505.00	47.48
9520.00	48.15	9520.00	47.46
9535.00	48.03	9535.00	47.50
9550.00	47.94	9550.00	47.50
9565.00	48.12	9565.00	47.28
9580.00	48.11	9580.00	47.72
9595.00	48.06	9595.00	47.43
9610.00	48.02	9610.00	47.52
9625.00	48.16	9625.00	47.62
9640.00	48.14	9640.00	47.48
9655.00	47.97	9655.00	47.55
9670.00	47.94	9670.00	47.48
9685.00	48.02	9685.00	47.69
9700.00	48.05	9700.00	47.41
9715.00	47.75	9715.00	47.42
9730.00	48.01	9730.00	47.56
9745.00	48.09	9745.00	47.55
9760.00	48.07	9760.00	47.58

Elapsed Time	Value	Elapsed Time	Value
9775.00	48.21	9775.00	47.67
9790.00	48.23	9790.00	47.81
9805.00	48.34	9805.00	47.65
9820.00	48.09	9820.00	47.65
9835.00	48.22	9835.00	47.88
9850.00	48.39	9850.00	47.55
9865.00	48.35	9865.00	47.67
9880.00	48.42	9880.00	47.88
9895.00	48.30	9895.00	47.86
9910.00	48.36	9910.00	47.66
9925.00	48.34	9925.00	47.60
9940.00	48.29	9940.00	47.76
9955.00	48.16	9955.00	47.64
9970.00	48.43	9970.00	47.72
9985.00	48.36	9985.00	47.71
10000.0	48.32	10000.0	47.97
10015.0	48.24	10015.0	47.96
10030.0	48.50	10030.0	47.73
10045.0	48.37	10045.0	47.68
10060.0	48.34	10060.0	47.65
10075.0	48.30	10075.0	47.67
10090.0	48.33	10090.0	47.65
10105.0	48.40	10105.0	47.92
10120.0	48.31	10120.0	47.79
10135.0	48.28	10135.0	47.70
10150.0	48.17	10150.0	47.67
10165.0	48.36	10165.0	47.92
10180.0	48.34	10180.0	47.60
10195.0	48.41	10195.0	47.97
10210.0	48.31	10210.0	47.88
10225.0	48.32	10225.0	47.65
10240.0	48.43	10240.0	47.95
10255.0	48.42	10255.0	47.88
10270.0	48.24	10270.0	47.71
10285.0	48.33	10285.0	47.93
10300.0	48.18	10300.0	47.71
10315.0	48.39	10315.0	47.84
10330.0	48.26	10330.0	47.69
10345.0	48.41	10345.0	47.90
10360.0	48.34	10360.0	47.55
10375.0	48.31	10375.0	47.73
10390.0	48.29	10390.0	47.80
10405.0	48.28	10405.0	47.73
10420.0	48.28	10420.0	47.81
10435.0	48.13	10435.0	47.70
10450.0	48.22	10450.0	47.67

Elapsed Time	Value	Elapsed Time	Value
10465.0	48.23	10465.0	47.84
10480.0	48.21	10480.0	47.60
10495.0	48.18	10495.0	47.62
10510.0	48.28	10510.0	47.88
10525.0	48.28	10525.0	47.49
10540.0	48.16	10540.0	47.72
10555.0	48.28	10555.0	47.73
10570.0	48.24	10570.0	47.62
10585.0	48.16	10585.0	47.65
10600.0	48.03	10600.0	47.56
10615.0	48.11	10615.0	47.66
10630.0	48.15	10630.0	47.85
10645.0	48.15	10645.0	47.69
10660.0	48.17	10660.0	47.75
10675.0	48.21	10675.0	47.68
10690.0	48.38	10690.0	47.76
10705.0	48.15	10705.0	47.62
10720.0	48.11	10720.0	47.71
10735.0	48.14	10735.0	47.49
10750.0	48.12	10750.0	47.57
10765.0	48.07	10765.0	47.80
10780.0	48.04	10780.0	47.58
10795.0	48.18	10795.0	47.41
10810.0	48.21	10810.0	47.57
10825.0	48.23	10825.0	47.71
10840.0	48.14	10840.0	47.49
10855.0	48.01	10855.0	47.44
10870.0	48.08	10870.0	47.55
10885.0	48.18	10885.0	47.52
10900.0	48.10	10900.0	47.43
10915.0	48.11	10915.0	47.49
10930.0	47.99	10930.0	47.55
10945.0	48.30	10945.0	47.73
10960.0	48.02	10960.0	47.46
10975.0	48.09	10975.0	47.65
10990.0	48.23	10990.0	47.60
11005.0	48.02	11005.0	47.46
11020.0	48.12	11020.0	47.58
11035.0	48.20	11035.0	47.50
11050.0	47.95	11050.0	47.61
11065.0	47.97	11065.0	47.52
11080.0	48.14	11080.0	47.57
11095.0	47.90	11095.0	47.55
11110.0	48.14	11110.0	47.45
11125.0	47.99	11125.0	47.51
11140.0	48.08	11140.0	47.57

Elapsed Time	Value	Elapsed Time	Value
11155.0	48.14	11155.0	47.69
11170.0	48.17	11170.0	47.62
11185.0	48.19	11185.0	47.58
11200.0	48.15	11200.0	47.69
11215.0	48.09	11215.0	47.71
END		END	

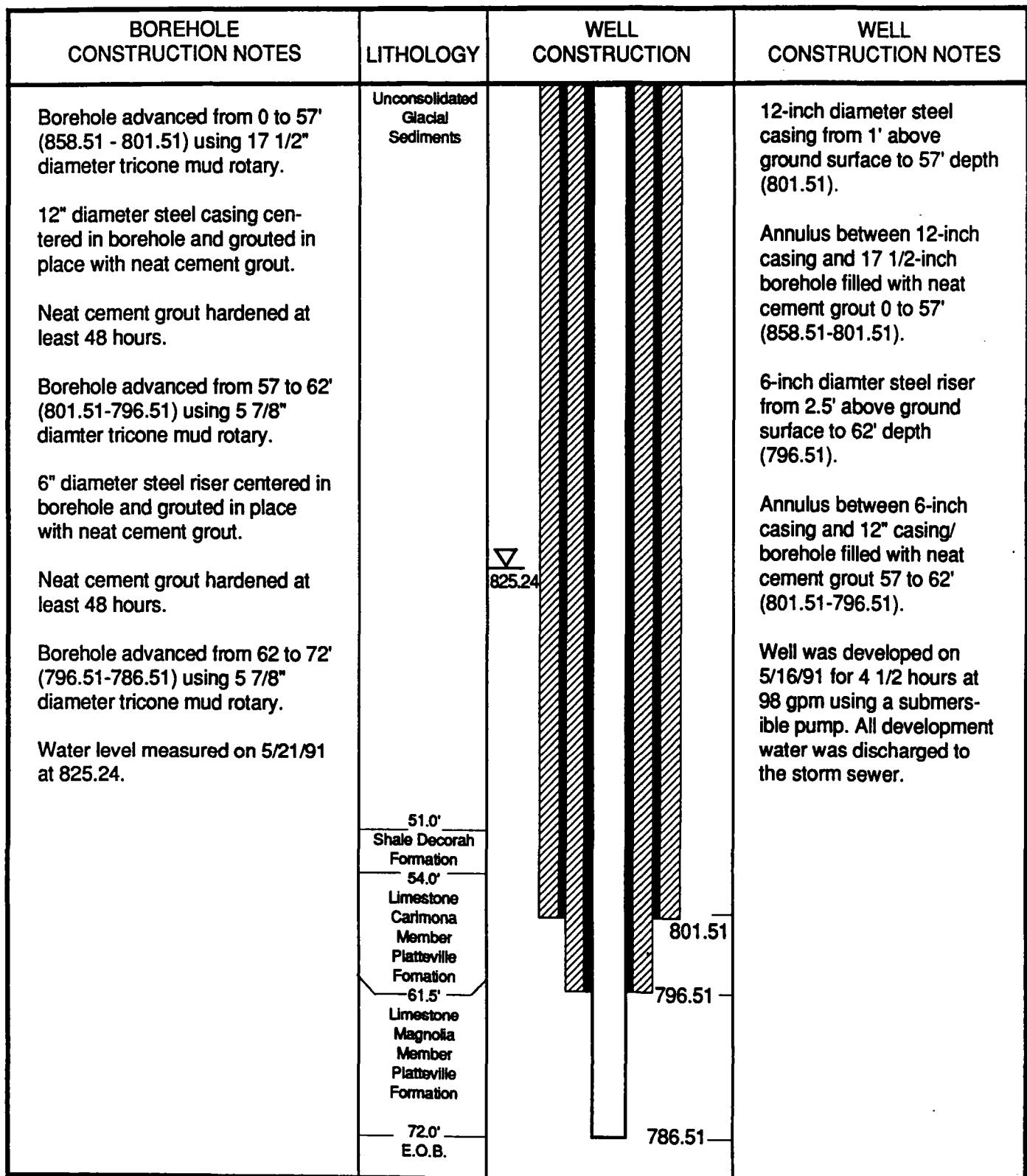
Appendix E

Magnolia Pump-out Wells (MG1 & MG2) Construction Well Logs

WELL LOG

BARR ENGINEERING CO.
Minneapolis, Minnesota

Project <u>General Mills</u>	Well No. <u>MG-1</u>
Date Started <u>5/8/91</u>	
Date Completed <u>5/15/91</u>	Riser Pipe Elevation <u>861.01</u>
Field Inspector <u>G. Remple (Barr)</u>	
Crew Chief <u>D. Davidson (F.H. Renner & Sons)</u>	Ground Surface Elevation <u>858.51</u>



Comments: Vertical Scale: 1" = 10', Elevations are in feet MSL

Sheet 1 of 1

BORING LOG

BORING NO.: MG-1

PROJECT: General Mills

DATE STARTED: 5/8/91

DATE COMPLETED: 5/15/91

FIELD INSPECTOR: G. Remple (Barr)

CREW CHIEF: D. Davidson (E.H. Renner & Sons)

RISER PIPE ELEVATION: 861.01

GROUND SURFACE ELEVATION: 858.51

Depth (Feet)	Net OVA (ppm)	Sample Type	Recovery (%)	Water Content	Profile	DESCRIPTION OF MATERIALS AND REMARKS
0	0					Unconsolidated Glacial Sediments.
5						
10	0					
15						
20	0					
25						
30						

COMMENT: 0-55: Drilled by tri-cone rotary method using 17.5-inch bit
55-62: Drilled by tri-cone rotary method using 11 7/8-inch bit.
62-72: Drilled by tricone rotary method using 5 7/8" bit.
Elevations are in feet MSL.

BORING LOG

PROJECT: General Mills

BORING NO.: MG-1

DATE STARTED: 5/8/91

RISER PIPE ELEVATION: 861.01

DATE COMPLETED: 5/15/91

GROUND SURFACE ELEVATION: 858.51

FIELD INSPECTOR: G. Remple (Barr)

CREW CHIEF: D. Davidson (E.H. Renner & Sons)

Depth (Feet)	Net OVA (ppm)	Sample Type	Recovery (%)	Water Content	Profile	DESCRIPTION OF MATERIALS AND REMARKS	
30	0					Same as above.	
35							
40	0						
45							
50	0					Depth: 51.0 (807.51)	
55	0					Decorah Formation	
60						Platteville Formation Carmona Member Limestone Moderately Hard Fine Grained 54-55 Slightly Weathered: Yellow - Gray 55-61.5 Unweathered: Gray to Dark Gray Non-swelling Non-slaking Clayey (Bentonite) seam at 59.5	Depth: 54.0 (804.51)

COMMENT: 0-55: Drilled by tri-cone rotary method using 17.5-inch bit

55-62: Drilled by tri-cone rotary method using 11 7/8-inch bit.

62-72: Drilled by tricone rotary method using 5 7/8" bit.

Elevations are in feet MSL.

BORING LOG

PROJECT: General Mills

BORING NO.: MG-1

DATE STARTED: 5/8/91

RISER PIPE ELEVATION: 861.01

DATE COMPLETED: 5/15/91

GROUND SURFACE ELEVATION: 858.51

FIELD INSPECTOR: G. Remple (Barr)

CREW CHIEF: D. Davidson (E.H. Renner & Sons)

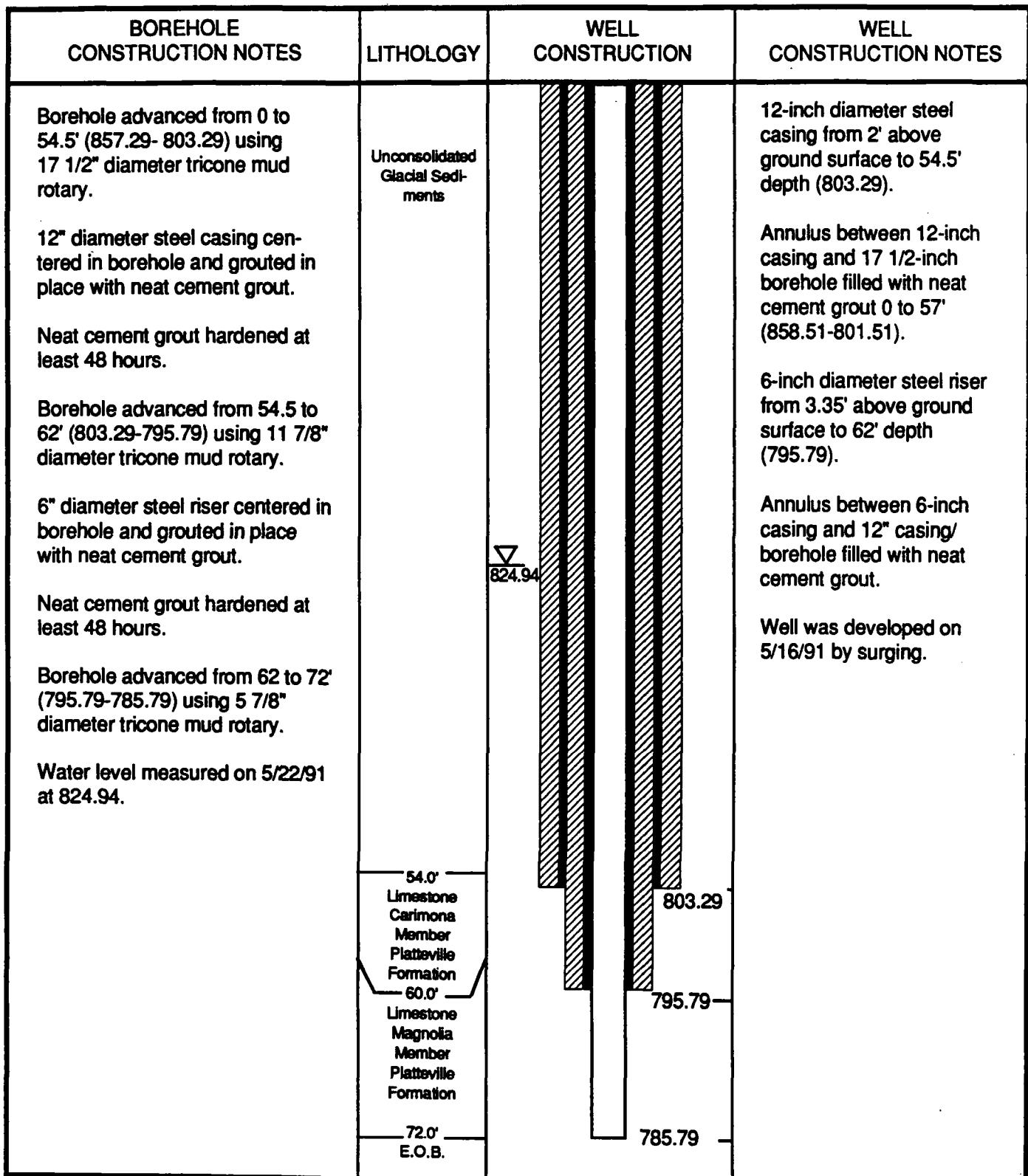
Depth (Feet)	Net OVA (ppm)	Sample Type	Recovery (%)	Water Content	Profile	DESCRIPTION OF MATERIALS AND REMARKS	
60	0					Same as above.	
						Depth: 61.5' (799.51)	
65	0					Platteville Formation Magnolia Member Limestone Moderately Hard Fine Grained Fossiliferous Unweathered Nonswelling Nonslacking Light gray Contains some secondary Pyrite Crystals	
						Depth: 71.0' (785.51)	
70	0					Same as above, slightly darker- possibly Hidden Falls Member	
						72.0' (786.51) End Of Boring	
75							
80							
85							
90							

COMMENT: 0-55: Drilled by tri-cone rotary method using 17.5-inch bit
 55-62: Drilled by tri-cone rotary method using 11 7/8-inch bit
 62-72: Drilled by tricone rotary method using 5 7/8" bit.
 Elevations are in feet MSL.

WELL LOG

BARR ENGINEERING CO.
Minneapolis, Minnesota

Project <u>General Mills</u>	Well No. <u>MG-2</u>
Date Started <u>5/14/91</u>	
Date Completed <u>5/20/91</u>	Riser Pipe Elevation <u>861.14</u>
Field Inspector <u>G. Remple (Barr)</u>	
Crew Chief <u>D. Davidson (E.H. Renner & Sons)</u>	Ground Surface Elevation <u>857.79</u>



Comments: Vertical Scale: 1" = 10', Elevations are in feet MSL

Sheet 1 of 1

BORING LOGPROJECT: General MillsBORING NO.: MG-2DATE STARTED: 5/14/91RISER PIPE ELEVATION: 861.14DATE COMPLETED: 5/20/91FIELD INSPECTOR: G. Remple (Barr)GROUND SURFACE ELEVATION: 857.79CREW CHIEF: D. Davidson (E.H. Renner & Sons)

Depth (Feet)	Net OVA (ppm)	Sample Type	Recovery (%)	Water Content	Profile	DESCRIPTION OF MATERIALS AND REMARKS
0	0					Unconsolidated Glacial Sediments.
5						
10	0					
15						
20	0					
25						
30						

COMMENT: 0-54.5: Drilled by tri-cone rotary method using 17.5-inch bit
54.5-62: Drilled by tri-cone rotary method using 11 7/8-inch bit.
62-72: Drilled by tricone rotary method using 5 7/8" bit.
Elevations are in feet MSL.

SHEET 1 OF 3

BORING LOG

PROJECT: General Mills
 DATE STARTED: 5/14/91
 DATE COMPLETED: 5/20/91
 FIELD INSPECTOR: G. Remple (Barr)
 CREW CHIEF: D. Davidson (E.H. Renner & Sons)

BORING NO.: MG-2
 RISER PIPE ELEVATION: 861.14
 GROUND SURFACE ELEVATION: 857.79

Depth (Feet)	Net OVA (ppm)	Sample Type	Recovery %	Water Content	Profile	DESCRIPTION OF MATERIALS AND REMARKS	
30	0					Same as above.	
35							
40	0						
45							
50	0						
55	0					Platteville Formation Carmona Member Limestone Moderately Hard Fine Grained 54-55 Slightly Weathered: Yellow - Gray 55-60 Unweathered: Gray to Dark Gray Non-swelling Non-slaking	Depth: 54.0 (804.51)
60							

COMMENT: 0-54.5: Drilled by tri-cone rotary method using 17.5-inch bit
 54.5-62: Drilled by tri-cone rotary method using 11 7/8-inch bit.
 62-72: Drilled by tricone rotary method using 5 7/8" bit.
 Elevations are in feet MSL.

BORING LOG

PROJECT: General Mills
DATE STARTED: 5/14/91
DATE COMPLETED: 5/20/91
FIELD INSPECTOR: G. Remple (Barr)
CREW CHIEF: D. Davidson (E.H. Renner & Sons)

BORING NO.: MG-2

RISER PIPE ELEVATION: 861.14
GROUND SURFACE ELEVATION: 857.79

Depth (Feet)	Net OVA (ppm)	Sample Type	Recovery (%)	Water Content	Profile	DESCRIPTION OF MATERIALS AND REMARKS	
60	0					Depth: 60.0' (785.79)	
65	0					Platteville Formation Magnolia Member Limestone Moderately Hard Fine Grained Fossiliferous Unweathered Nonswelling nonslaking	
70	0					Depth: 71.0' (784.79)	
						Same as above, slightly darker- possibly Hidden Falls Member	
75						72.0' (785.79)	
80						End Of Boring	
85							
90							

COMMENT: 0-54.5: Drilled by tri-cone rotary method using 17.5-Inch bit
54.5-62: Drilled by tri-cone rotary method using 11 7/8-Inch bit.
62-72: Drilled by tricone rotary method using 5 7/8" bit.
Elevations are in feet MSL.